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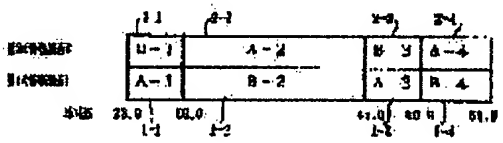
NAGANO HIROBUMI

(54) OPTICAL RECORDING MEDIUM AND APPARATUS FOR REPRODUCING IT

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent an optical disc supplying software or music data from being copied while hardly increasing the cost of the optical disc.
SOLUTION: A digital signal data A or B representing one data of an image, music, a program, etc., is divided in two or more by a unit smaller than the recordable amount of data of one data-recording face. The data are recorded separately to two or more different data-recording faces, so that the data recorded to the data-recording faces are discontinuous. The data A and the data B are recorded to one data-recording face fragmentarily in a mixed state. Even when data-recording faces of an optical disc are totally copied, the data A and B are fragmentarily mixed and any of the data A and B forms a meaningless disc not fulfilling one complete single data. Accordingly, illegal copying can be prevented.



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United States Patent [19]

Kondo et al.

[11] Patent Number: 6,122,245

[45] Date of Patent: Sep. 19, 2000

[54] **OPTICAL RECORDING MEDIUM AND REPRODUCING APPARATUS FOR OPTICAL RECORDING MEDIUM**

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[73] Assignee: **Victor Company of Japan, Ltd.,** Yokohama, Japan

[21] Appl. No.: **09/141,011**

[22] Filed: **Aug. 26, 1998**

Related U.S. Application Data

[62] Division of application No. 08/724,775, Oct. 3, 1998, Pat. No. 5,841,861.

[30] **Foreign Application Priority Data**

Oct. 6, 1995 [JP] Japan 7-286447

[51] **Int. Cl.**[7] **G11B 7/24**; H04L 9/00

[52] **U.S. Cl.** **369/275.4**; 380/4

[58] **Field of Search** 369/275.4, 58, 369/275.3, 54, 84, 83, 94, 44.26, 47–48; 360/15, 13, 60; 380/4, 49

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,696,757	12/1997	Ozaki et al.	369/275.4
5,699,434	12/1997	Hogan	380/49
5,841,861	11/1998	Kondo et al.	380/4

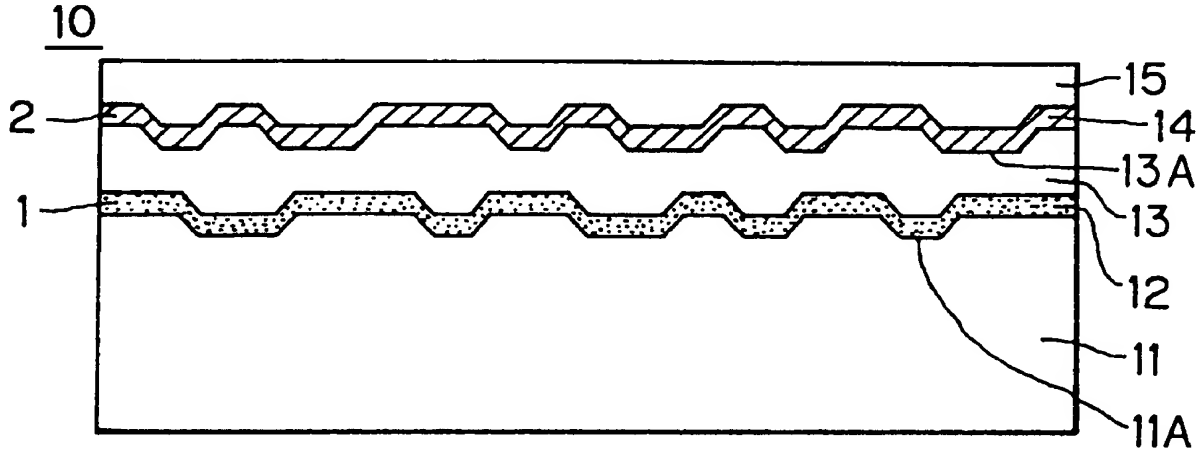
Primary Examiner—Ali Neyzari

Attorney, Agent, or Firm—Anderson, Kill & Olick P.C.

[57] **ABSTRACT**

An optical recording medium has a plurality of layers of recorded information including at least digital data of picture, music, or computer software in a form of recorded marks or pits readable by optical means. The digital data is divided into a plurality of data groups, each group being smaller than a recordable capacity of each layer, and the divided data groups are distributed among the plurality of layers so that an original digital data become discontinuous within each layer.

9 Claims, 3 Drawing Sheets



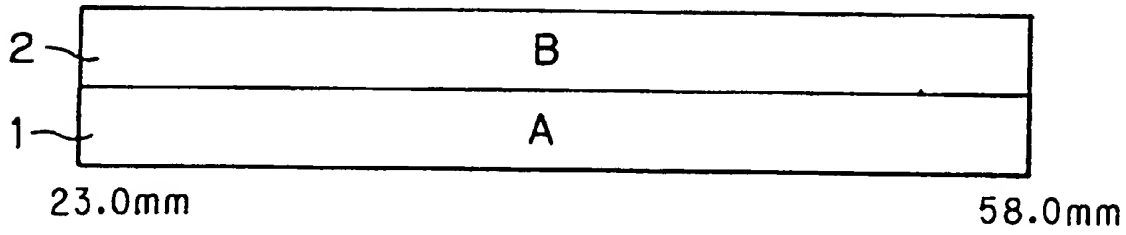


Fig.1 Prior Art

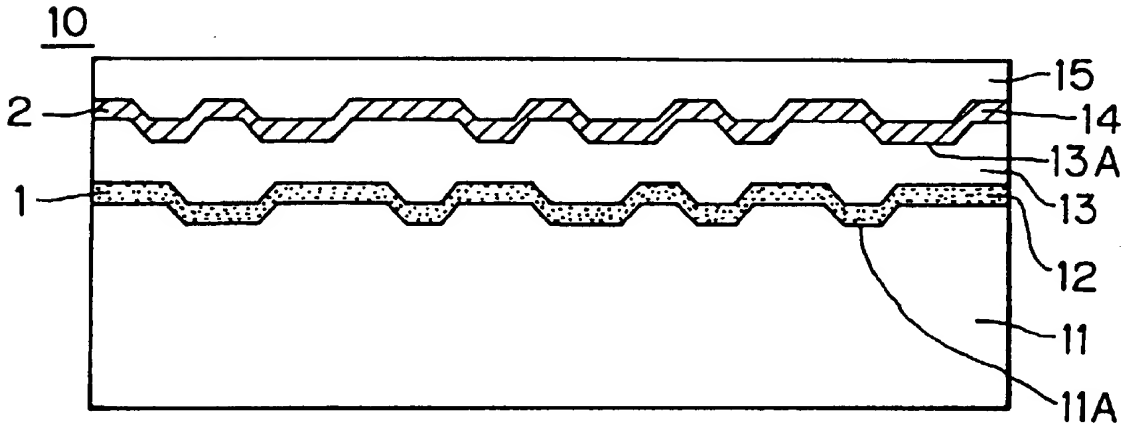


Fig.2

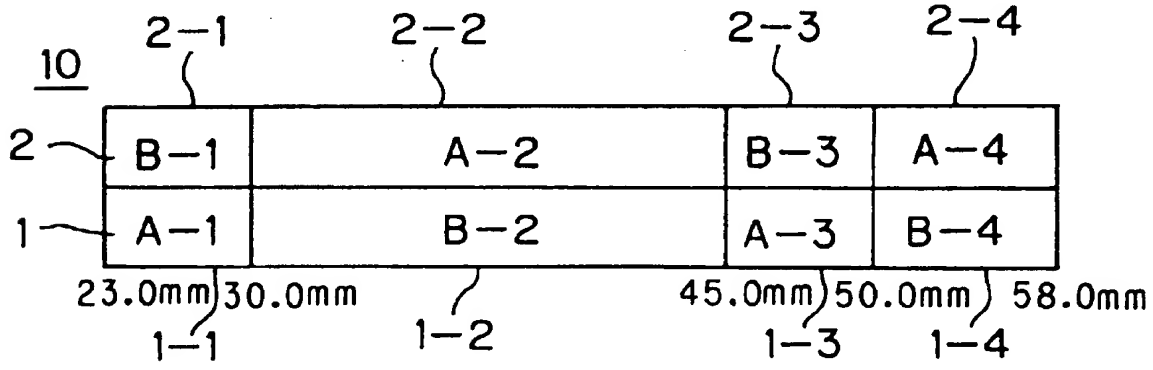


Fig.3

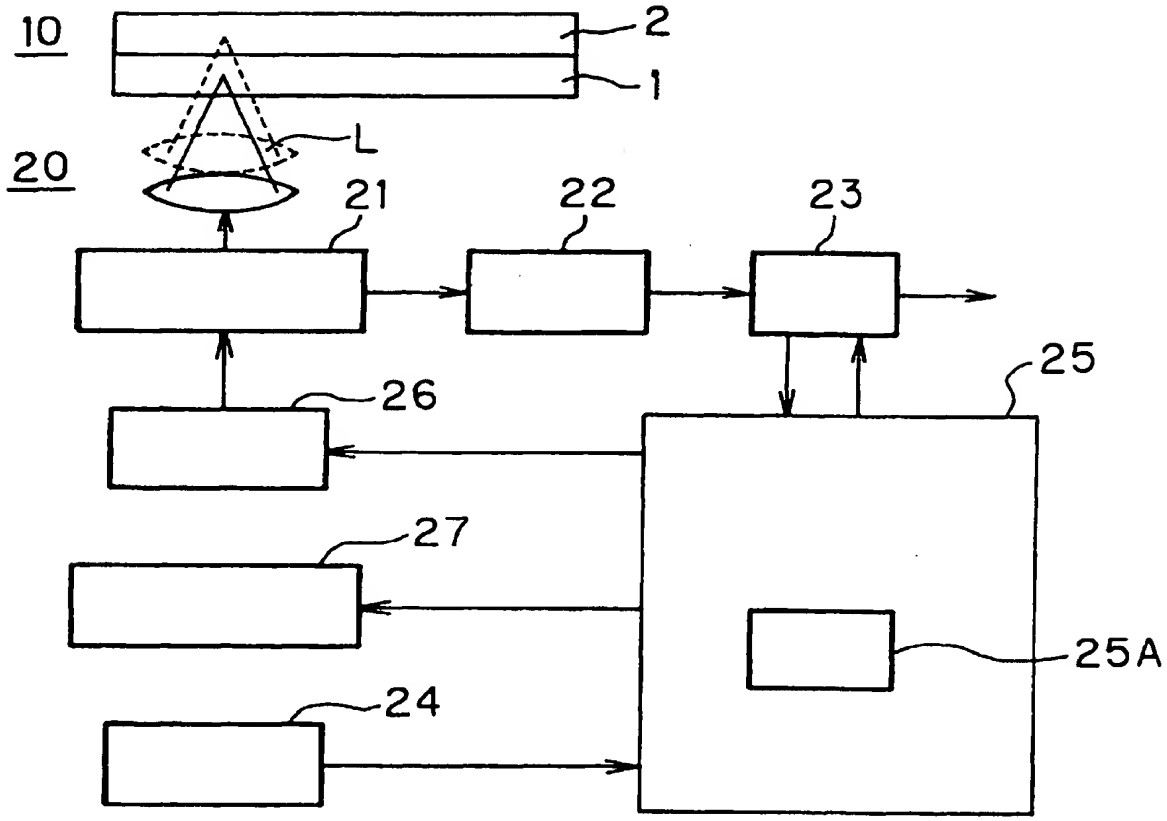

10
2
1
L
20
21
22
23
25
26
27
25A
24

Fig.4

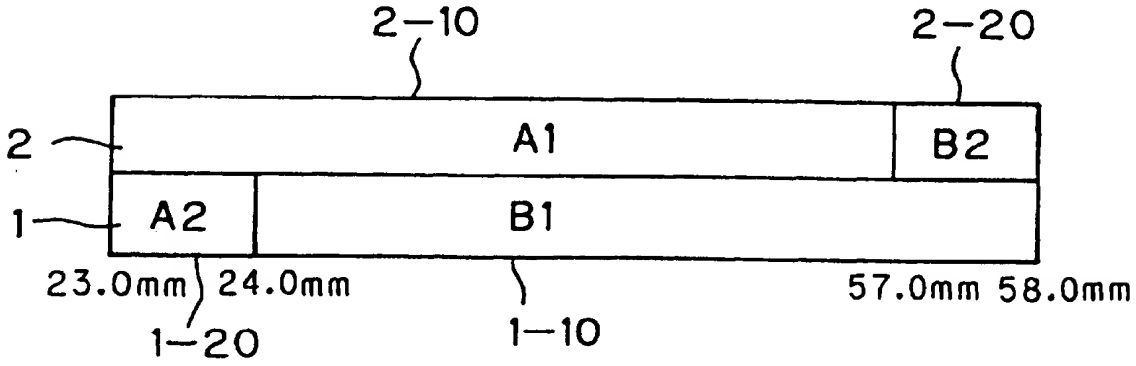

2-10
2-20
2
A1
B2
1
A2
B1
23.0mm
24.0mm
57.0mm
58.0mm
1-20
1-10

Fig.5

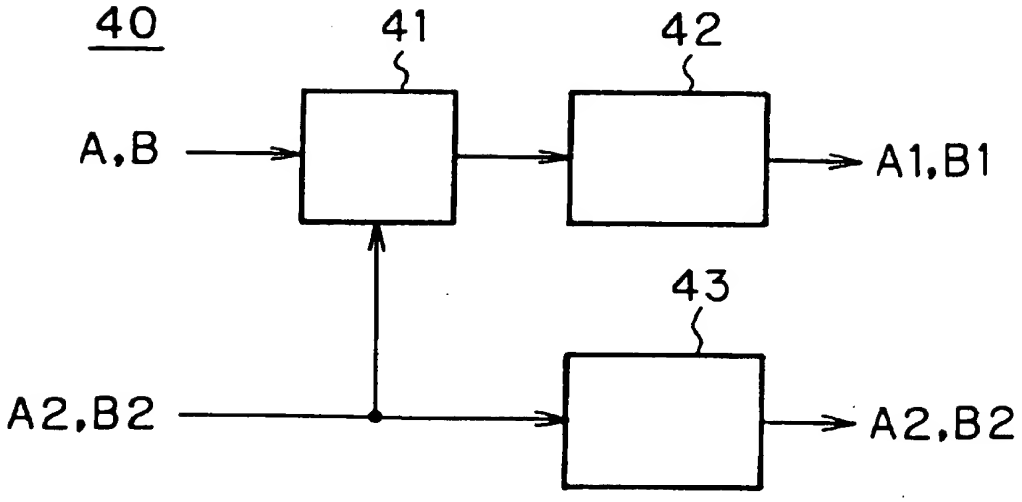


Fig.6

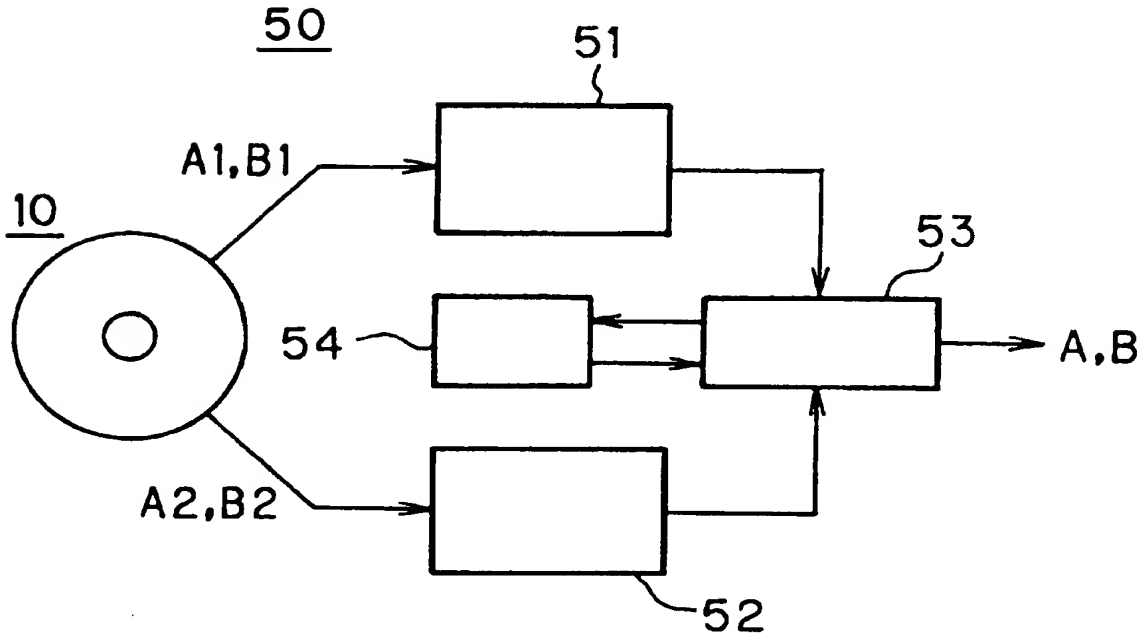


Fig.7

OPTICAL RECORDING MEDIUM AND REPRODUCING APPARATUS FOR OPTICAL RECORDING MEDIUM

This application is a divisional application of U.S. patent application Ser. No. 07/724,775 filed Oct. 3, 1998, now U.S. Pat. No. 5,841,861.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an optical recording medium and a reproducing apparatus, in particular, relates to a copy-protection type optical recording medium and the reproducing apparatus for the optical recording medium.

2. Description of the Related Art

Presently, there are widely used a read-only-type optical disc such as a CD (Compact Disc) for recording music information or a CD-ROM (Read-Only-Memory) for recording information such as a computer software and a database, an additionally-writable-type disc such as a write once (WO) disc on which information can be written only once, and an erasable-type disc such as a magneto-optical (MO) disc on which information can be repeatedly written. As well known, it can be easily performed to read out data recorded on a read-only-type optical disc and to record the data obtained therefrom, for instance, on another additionally-writable-type optical disc. Presently, there is rarely considered a measure to protect the music information, the computer software and the database recorded on the read-only-type optical disc from being copied. Therefore, an illegal copying can be easily performed on original CDs and CD-ROMs.

In recording a precious software on the read-only-type optical disc, however, there has been taken a measure to protect such precious software from illegal copying by employing a hardware key or a special data disc referred to as a key disc for the protection.

In the above method, however, it requires the hardware key or the key disc to protect the software from being illegally copied in addition to the recording medium for recording the software, which poses an increase of cost of the software and gives users a potential problem that the recording medium becomes impossible to be used upon breakage or loss of the hardware key or the key disc.

Recently, an optical disc which has more than two layers of information recording in the direction of its thickness is available, and for such an optical disc, a copy protection function is also required.

SUMMARY OF THE INVENTION

Accordingly, a general object of the present invention is to provide a novel and useful optical disc having a copy protection function for software or music recorded thereon and a reproducing apparatus for the optical disc without an increase of cost.

A specific object of the present invention is to provide an optical recording medium comprising a data recording area which has more than one layer of recorded digital data as marks or bits being readable optically and containing information such as pictures, music, computer software, the digital data are divided into more than one group, each group contains an amount of data smaller than a full recordable capacity of each layer of the optical disc, and the divided digital data are recorded on different layers of the optical disc each other so that an original data stream becomes discontinuous on each layer.

Another specific object of the present invention is to provide an optical recording/reproducing apparatus having more than two information recorded layers of which digital data are optically readable and contain information such as pictures, music, computer software, the digital data having main data and a cipher key, the information being ciphered to the main data, the cipher key defining a method of ciphering and deciphering, and the main data and the cipher key being recorded on different layers of the optical recording medium each other.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a sectional view of a part of an optical disc of the prior art.

FIG. **2** shows a sectional view of a part of an optical disc of the present invention.

FIG. **3** shows a signal recorded structure on the optical disc of a first embodiment of the present invention shown in FIG. **2**.

FIG. **4** shows a block diagram of a main part of a signal reproducing apparatus of the present invention using the optical disc shown in FIG. **2**.

FIG. **5** shows a signal recorded structure on the optical disc of a second embodiment of the present invention.

FIG. **6** shows a block diagram of a main part of a signal recording apparatus of the present invention for recording the optical disc having the signal recording structure shown in FIG. **5**.

FIG. **7** shows a block diagram of a main part of a signal reproducing apparatus of the present invention for recording the optical disc having the signal recording structure shown in FIG. **5**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described in detail with reference to the accompanying drawings.

An optical disc of the present invention relates to an optical disc having more than two recorded layers, and a description will also include a signal recording/reproducing apparatus of the present invention which uses an optical disc having two recorded layers in the direction of its thickness, and for a convenience of explanation, recording/reproducing process in the present invention deals exemplary with two digital data groups A and B. Each of the digital data groups A and B is one or a combination of information such as picture, music, and computer software, and has an amount which is smaller than a recordable capacity of one layer of the optical disc.

An optical disc of the present invention is described in the following.

FIG. **2** shows a sectional view of a part of an optical disc of the present invention.

As shown in FIG. **2**, the optical disc of the present invention has two recorded layers.

In FIG. **2**, an optical disc **10** has a transparent substrate **11**, a first reflective layer **12**, a transparent layer **13**, a second reflective layer **14**, and a protection layer **15**. A signal pit **11A** forming a first information layer **1** of recorded information is formed on the transparent substrate **11**. Another signal pit **13A** forming a second information layer **2** of recorded information is formed. The first reflective layer **12** is made of a semi-transparent material which transmits a part of a light beam, and reflects another part of it, so as to lead

the light beam to the second information layer **2**. As a result, the information recorded on the first and second information layers can selectively be read by changing a focal point of a laser beam.

First Embodiment

FIG. **2** shows a sectional view of a part of an optical disc of the present invention.

FIG. **3** shows a signal recording structure on the optical disc of a first embodiment of the present invention shown in FIG. **2**.

First embodiment of the present invention will now be described referring to FIG. **3**.

In FIG. **3**, horizontal lines correspond to the radial direction of the optical disc **10**. An information recorded area of the optical disc **10** of the present invention is between radiuses 23 mm and 58 mm in its radial direction. The first and second layers **1** and **2** of recorded information are shown in its vertical direction.

Each of the digital data groups A and B is divided into more than two sub-groups wherein each sub-group has a smaller amount of data than a recording capacity of one layer, and the digital data groups A and B are recorded on the two layers in a manner that any of the data groups A and B is no longer continuous. As a result, within any layer of the two digital data groups A and B are mixed each other in units of sub-groups and recorded on the first and second information layers **1** and **2** of the optical disc **10**. In FIG. **3**, the digital data group A is divided into groups A-**1**, A-**2**, A-**3**, and A-**4**, and recoded on an area (area **1**-**1**) between 23 mm and 30 mm of the first information layer **1** in its radial direction, an area (area **2**-**2**) between 30 mm and 45 mm of the second information layer **2**, an area (area **1**-**3**) between 45 mm and 50 mm of the first information layer **1**, and an area (area **1**-**4**) between 50 mm and 58 mm of the second information layer **2** respectively. Similarly, the digital data group B is divided into groups B-**1**, B-**2**, B-**3**, and B-**4**, and recorded on an area (area **2**-**1**) between 23 mm and 30 mm of the second information layer **2**, an area (area **1**-**2**) between 30 mm and 45 mm of the first information layer **1**, an area (area **2**-**3**) between 45 mm and 50 mm of the second information layer **2**, and an area (area **1**-**4**) between 50 mm and 58 mm of the first information layer **1** respectively. Positional information (radial position, address and the like) for each sub-group is recorded on a predetermined position, such as a TOC (Table of Contents), an innermost track of the optical disc **10**, or in a memory of a reproducing apparatus.

Now back to a conventional method of digital data recording on an optical disc, description will be given with reference to FIG. **1**.

FIG. **1** shows a sectional view of a part of an optical disc of the prior art.

In the prior art, two digital data groups are recorded individually and continuously of each data group on an optical disc, namely, the digital data group A is recorded on the first information layer **1** continuously, and the digital data group B on the second information layer **2** continuously. In this case, the digital data groups A and B can be copied intactly by a serial data reproduction and recording on another optical medium and reproduced therefrom easily.

On the other hand, when the digital data groups are copied from the optical disc **10** of the present invention, as shown before, each of the digital data groups is no longer continuous, thus a complete reproduction of the original digital data group or groups will not be obtained. Thus, the original digital data is protected from an illegal copy.

A reproducing apparatus of the optical disc **10** of the present invention will be explained referring to FIG. **4**.

FIG. **4** shows a block diagram of a main part of a signal reproducing apparatus **20** of the present invention using the optical disc shown in FIG. **2**.

In FIG. **4**, the optical disc **10** has two information layers **1** and **2**. Two digital data groups A and B are mixed each other and recorded on the two information layers, as shown before.

Thus recorded digital data are read out by utilizing an optical pickup **21**. Optical signals of the digital data are detected and converted to electric signals by a head amplifier **22**. The electric signals are sent to a signal processing circuit **23**, and outputted as digital data.

Reproduction of the recorded digital data on each information layer **1** or **2** is performed by a conventional focusing technology. A light beam L is focused on an objective information layer **1** or **2** by moving the optical pickup **21** up or down. The information layers **1** and **2** are formed approximately parallel with each other, therefore, the light beam L can be focused on either information layer **1** or **2** by moving the optical pickup **21** up or down. Thus, the reproduction of the recorded digital data on each recorded layer is performed.

The optical disc **10** is set on a reproducing apparatus **20**. A disc detector **24** detects a presence of the optical disc **10**, and produces and sends a signal of disc detection to a microcomputer **25**. The microcomputer **25** commands a disc drive apparatus **27** to drive the optical disc **10**. The microcomputer **25** also commands a optical pickup drive apparatus **26** to drive the optical pickup **21**, and to reproduce the TOC which is on the optical disc **10**. The TOC is a time code information and an address information which show how the digital data groups A and B are divided and where they are recorded. The address information reproduced from the TOC is stored on a memory **25A** provided in or out of the microcomputer **25**. The microcomputer **25** outputs an optical pickup control information according to the address information to the optical pickup drive apparatus **26**. The optical pickup drive apparatus **26** controls seeking operation of the optical pickup **21** and switching a focal point thereof between the first and second information layers **1**, **2** according to a control signal produced by the microcomputer **25**. When the data group A is intended to be reproduced, the light beam L is focused on the first information layer **1**, and read out the sub-group A-**1** at first. Upon the light beam L reaches to the end of the sub-group A-**1**, namely, the radial distance of 30 mm, the light beam L is focused to the second information layer **2** for the sub-group A-**2**, which is the area **2**-**2**. The rests of the sub-groups are similarly reproduced. The sub-groups A-**3**, and A-**4** are continuously reproduced by changing the focus distance of the optical pickup **21**.

Advantages of the present invention will be given by describing how an illegal replication of this optical disc is prevented.

a) A replication process utilizing a conventional recording/reproducing device.

In the following, it is assumed that an illegal copy is performed on a plurality of optical discs each having only one information layer for recording.

Generally, a conventional reproducing apparatus reads out continuously, data on one information layer at a time. Using this apparatus, the illegal copy is assumed that the respective contents of the first and second information layers **1** and **2** of the optical disc **10** (FIGS. **2** and **3**) are read in the order and recorded on other two single layer optical discs. As a

result, the one of the two discs has the content of the first information layer 1, and another has that of the second information layer 2. When one of these discs is attempted to be reproduced by utilizing the reproducing apparatus shown in FIG. 4, the restoration of the original data group is not possible because of a lack of the data on the another disc, and the focal point switching operation according to the TOC will become erratic. When a reproduction of one of the illegally copied disc is attempted by a conventional single layer disc reproducing apparatus, a complete restoration of the original digital data group A or B is not possible because the data on the illegally copied optical disc is a mixture of the original digital data groups A and B. Thus, the contents of the disc of the present invention is protected from an illegal copy.

b) Replication by physically transferring the data to another disc.

Replicas can be made by utilizing a physical transferring method without utilizing a reproducing device. The protection layer **15** (ultraviolet ray curing resin) which cover the surface of the disc **10**, and the second reflective layer **14** (Aluminum) are removed by an alkaline solvent. Then the recorded layer (signal pit **13**A) of the disc is exposed. Thereafter, a stamper can be produced from the disc by a conventional process such as depositing a metal film on the exposed recorded layer, and further plating a metal on the metallized recorded layer. The stamper can produce a large number of replicas. However, other than the first information layer **1** which is manufactured by injection molding a plastic material, the other layers, such as a transparent layer **13** and the protection layer **15** are usually made of ultra-violet ray curing resin, and, a first and the second reflective layers **12** and **14** are usually made of Aluminum, thus they melt away by the alkaline solvent. Therefore, the replica which may be manufactured only from the remaining first information layer, is useless as it carries a partial mixture of the original digital data groups A and B. Thus, the contents of the disc of the present invention is protected from an illegal copy.

Second Embodiment

Second embodiment of the present invention will now be described referring to FIGS. **4** through **7**.

FIG. **5** shows a signal recorded structure on the optical disc of a second embodiment of the present invention.

As shown in FIG. **5**, original digital data groups A and B are ciphered in relation to respective cipher key A2 and B2, and recorded on a optical disc **10** respectively as ciphered data groups A1 and B1. This ciphering process of the original data groups A and B of the second embodiment is different from the first embodiment. The cipher key A2 for the ciphered data group A1, is recorded on a cipher key recording area **1–20** of the optical disc **10**. The ciphered data group B1 is recorded on a data recording area **1–10** of the optical disc **10**. Similarly, the cipher key B2 for the ciphered data group B1, is recorded on a cipher key recording area **2–20** of the optical disc **10**. The ciphered data group A1 is recorded on a data recording area **2–10** of the optical disc **10**. As shown above, the ciphered data group and the cipher key for the ciphered data are not recorded on a same layer, thus the content of the original disc of the present invention is protected from an illegal copy when the information layers are attempted to be copied individually. When this principle, that the cipher key and the related data group to be deciphered thereby are not recorded on a same information layer each other, is applied to an optical disc having three or more information layers, the original digital data groups can not be restored. When the cipher key and the related ciphered data group are recorded on different information layers each other, they can be recorded on any information layers, and any positions thereof. Each of the cipher key and the related ciphered data are not required to be continuous, and can be divided into various parts. For example, the cipher key B2 may be divided into cipher keys B2-1 and B2-2, and the cipher key B2-1 may be recorded on an area between 40.0 mm and 40.5 mm in a radial direction of the optical disc, and the cipher key B2-2 may be recorded on the area between 57.5 mm and 58.0 mm thereof. On the residual area thereof, the ciphered data group A1 may be recorded.

The ciphered data groups A1, B1, and the cipher keys A2, B2 are recorded on the optical disc **10** utilizing a recording apparatus **40** shown in FIG. **6**.

FIG. **6** shows a block diagram of a main part of a signal recording apparatus of the present invention for recording the optical disc having the signal recording structure shown in FIG. **5**.

In FIG. **6**, a ciphering device **41** ciphers the original digital data groups A ,B in relation to the cipher keys A2, B2 respectively. A main data recording device **42** records the ciphered data groups A1, B1 on the optical disc **10**. A cipher key recording device **43** records the cipher keys A2, B2 on the optical disc **10**.

An operation of the recording apparatus **40** will now be explained.

The original data groups A, B are inputted to the ciphering device **41**, and the ciphering device **41** ciphers the original data groups A, B respectively by utilizing corresponding cipher keys A2, B2. The method of ciphering is, for example, to divide data into a plurality of groups having few bits of data, and to shift each bit to the right or left within a group. The ciphering apparatus **41** is preliminary built with a predetermined ciphering rules of above as a firmware. The cipher key contains ciphering and deciphering information as well as their rules.

As shown before, the ciphering apparatus **41** ciphers the original digital data groups A, B into the ciphered data groups A1, B1, utilizing the cipher keys A2, B2. The ciphered data groups A1, B1 are outputted to the main data recording device **42**. The main data recording device **42** records the ciphered data groups A1, B1 on an optical disc **10** by a conventional recording technology. The ciphered data group A1 is recorded on the data recording area **2–10** of the second information layer **2**. The ciphered data group B1 is recorded on the data recording area **1–10** of the first information layer **1**.

The cipher keys A2, B2 are inputted to the cipher key recording device **43** and to the ciphering apparatus **41**. The cipher key information recording device **43** records the cipher key A2 on the cipher key recording area **1–20**, the cipher key B2 on the cipher key recording area **2–20**.

As shown before, the optical disc **10** recorded with the cipher keys A2, B2 and the ciphered data groups A1, B1 ciphered by the cipher keys A2, B2, is provided. If the cipher keys A2, B2 are unknown, the optical disc **10** cannot be read, and the original data groups A, B cannot be restored from the ciphered data groups A1, B1. It is natural that the more the ciphering is intricate, the more the deciphering becomes difficult, and the more the copy protection becomes effective.

An optical disc reproducing apparatus of the present invention will be explained in the following.

FIG. **7** shows a block diagram of a main part of a signal reproducing apparatus of the present invention for repro-

ducing the optical disc having the signal recording structure shown in FIG. **5**.

As shown in FIG. **7**, a signal reproducing apparatus **50** has a main data reading device **51** for reading the ciphered data groups **A1**, **B1** on the data recording areas **1–10** and **2–10** of the optical disc **10**, a cipher key reading device **52** for reading the cipher keys **A2**, **B2** on the cipher key recording areas **1–20** and **2–20**, a deciphering device **53** for deciphering the ciphered data groups **A1**, **B1** using the cipher keys **A2**, **B2**, and restoring the original digital data groups A, B, and a RAM (Random Access Memory) **54** for storing the deciphering rules. When referred to the signal reproducing apparatus **20** shown in FIG. **4**, the main data recording device **51** and the cipher key reading device **52** correspond to the optical pickup **21**, and the RAM **54** and the deciphering device **53** correspond to the rest of the constituting elements of the signal reproducing apparatus **20** in FIG. **4**. The original digital data group A is restored from the ciphered data group A1 recorded on the second information layer **2**, by using the cipher key A2 on the first information layer **1**. Similarly, the original data group B is restored from the ciphered data group B1 on the first information layer **1**, using the cipher key B2 on the second information layer **2**.

The signal reproducing apparatus **50** will be explained following.

At first, the cipher keys **A2**, **B2** on the optical disc **10** (not shown) are read by the cipher key reading device **52**, and an output thereof is supplied to the deciphering device **53**. In the deciphering device **53**, deciphering of the ciphered data groups is performed by using the cipher keys **A2**, **B2** according to the deciphering rules determined and stored in the RAM **54**. The deciphering rules, for example, are to divide the ciphered data group A1 or B1 into x segments, and to shift each data bit within each segment by y bits to the direction of z. The deciphering rules are determined respectively for the ciphered data groups A1 and B1 as such that x is 4, y is 1, and z is right for example. Thus determined deciphering rules are stored in the RAM **54**. In the above, "x" is a number of the segments, "y" is the amount of bit to be shifted, "z" means the direction right or left.

After the deciphering rules are set in the deciphering device **53**, the ciphered data groups **A1**, **B1** are read by the main data reading device **51**, and an output thereof is supplied to the deciphering device **53**. The deciphering device **53** deciphers the ciphered data groups **A1**, **B1** according to the deciphering rules determined and stored in the RAM **54** for respective ciphered data groups A1, B1. Thus, the original digital data groups A, B are restored respectively, and outputted from the deciphering device **53**.

In consideration of reproduction convenience, positional information, that is, information to identify recorded positions of the ciphered data groups **A1**, **B1** and the cipher keys **A2**, **B2** of their layers and radial distances, are recorded somewhere on the disc **10** separately from the rest, but desired to be in the area where the light beam L of the optical pickup **21** searches first. This area, for instance, may be an inner guard area so called a lead-in area of a first information layer of the MM (MultiMedia) CD-typeII (a proposed industry standard) or of a DVD (digital video disc). In this area, there is a TOC having various information such as a recording time-length in each information layers, program titles, and index numbers. Information layer numbers and the radial distances of both the cipher keys **A2**, **B2** and the ciphered data groups **A1**, **B1** may be recorded together with the TOC in this area.

As mentioned before, in the optical disc of the present invention, the ciphered data, and the cipher key for determining the deciphering rules for the data are recorded on different layers of the optical disc each other. Therefore, the contents of the optical disc of the present invention is protected from an illegal copy.

Variation of the recording area of the cipher keys **A2**, **B2** will be described in the following.

The cipher keys **A2**, **B2** are recorded following to TOC, within the lead-in area. The cipher keys **A2**, **B2** have a signal format being same as that of the ciphered data groups **A1**, **B1**, and are recorded in a mastering process. In this case, the optical pickup **21** for reading the ciphered data groups **A1**, **B1**, is also utilized as the cipher key reading device **52**. Accordingly, this arrangement provides an inexpensive optical reproducing device for copy protection because the optical pickup **21** is utilized for reproducing both the ciphered data groups **A1**, **B1** and the cipher keys **A2**, **B2**.

The cipher keys **A2**, **B2** may be bar codes recorded or printed at different radial positions for respective layers. The bar codes can be recorded by various methods, such as mastering as pit patterns, deposition of reflective films utilizing stencil masks, or ink printing. When bar codes are employed, the signal reproducing apparatus **50** has a bar-code reader as the cipher key reading device **52**, which reads the cipher keys **A2**, **B2**, according to the information of the TOC. In this method, the ciphered data groups **A1**, **B1** and the cipher keys **A2**, **B2** are read by different data reading devices each other, therefore, the cipher keys **A2**, **B2** are protected more securely. As the bar-code reader, a magnetic sensor or a capacitance sensor can be used instead of optical sensor depending on the material of the bar-code.

The cipher keys **A2**, **B2** are recorded at a same radial distance but on different layers of the optical disc **10**. However, they can be placed in different angular positions each other depending on the information layer. For example, the cipher key A2 on the first information layer is between 10 and 50 degrees, on the second information layer, between 60 and 100 degrees, and on the third information layer if any, between 110 and 150 degrees. After the bar-code reader reads the all information of the cipher keys **A2**, **B2**, a desired cipher key is selected by referring to the information of the TOC. The TOC will have an information of the recorded angles of the cipher keys if needed. In this method, the bar-code reader can be stationary, therefore, the mechanism of the optical pickup can be simple.

The above mentioned copy protection technologies of the present invention can be combined to conventional copy protection methods.

The above mentioned copy protection technologies of the present invention can be adapted to a laminated multilayer disc, a partial ROM disc, and a writable disc.

According to the present invention, an optical recording medium has more than two information layers from which digital data are optically readable. Such recording medium may contain information such as pictures, music, computer software. The digital data representing the above include ciphered data and a cipher key, the cipher key determines a method of ciphering and deciphering, and the ciphered data and the cipher key are recorded on different layers of the optical medium each other. Thus, the optical recording medium of the present invention can protect its contents from an illegal copy.

What is claimed is:

1. A recording method of an optical recording medium wherein said optical recording medium comprising a plurality of layers of recorded digital data with at least one layer having digital data arranged as original data groups in a form

of marks or pits readable by optical means, said original digital data groups of said one layer being divided into a plurality of sub-data groups, each of said plurality of sub-data groups containing an amount of data smaller than a full recordable capacity of each of said plurality of layers, and said plurality of sub-data groups distributed among said plurality of layers so that said original digital data groups of at least said one layer becomes discontinuous within each of said plurality of layers, and wherein said recording method comprising a step of dividing said digital data arranged as original data groups into said plurality of sub-data groups containing an amount of data smaller than a full recordable capacity of each of said plurality of layers, and a further step of recording said plurality of sub-data groups distributed among said plurality of layers so that said original digital data groups of at least said one layer becomes discontinuous within each of said plurality of layers.

2. A recording method of an optical recording medium, wherein said optical recording medium comprising a plurality of layers of recorded digital data with at least one of said plurality of layers having digital data arranged as original digital data groups in a form of marks or pits readable by optical means, said original digital data groups divided into a plurality of sub-data groups, each of said plurality of sub-data groups containing main data and a cipher key, said main data being ciphered from said one of the original digital data groups, and said main data and said cipher key being recorded on different layers of said plurality of layers, and wherein said recording method comprising a step of dividing said digital data arranged as original data groups into a plurality of sub-data groups containing main data and a cipher key, said main data being ciphered from said one of the original digital data groups, said cipher key determining a deciphering method of said main data, and a further step of recording said main data and said cipher key being recorded on different layers of said plurality of layers.

3. A recording method as claimed in claim 2, wherein said cipher key is recorded on a lead-in area of said optical recording medium.

4. A recording method of an optical recording medium, wherein said optical recording medium comprising a plurality of layers of recorded digital data with at least one of said plurality of layers having digital data arranged as original digital data groups in a form of marks or pits readable by optical means, said original digital data groups divided into a plurality of sub-data groups, each of said plurality of sub-data groups containing main data and a cipher key, said main data being ciphered from said one of the original digital data groups, and said main data and said cipher key being recorded on different layers of said plurality of layers, and wherein said recording method comprising a step of recording said cipher key to be reproduced by other readout means than readout means for said main data.

5. An optical recording medium comprising:

a plurality of layers of recorded digital data with at least one of said plurality of layers having digital data arranged as original digital data groups in a form of marks or pits readable by optical means,

said original digital data groups divided into a plurality of sub-data groups,

each of said plurality of sub-data groups containing main data and a cipher key, and

said main data and said cipher key being recorded on different layers of said plurality of layers,

wherein said cipher key is recorded to be reproduced by other readout means than readout means for said main data.

6. A reproduction apparatus for reproducing an optical recording medium having a plurality of layers of recorded data including at least one of original digital data groups, the recorded data being in a form of marks or pits readable by optical means, sub-data groups containing main data and a cipher key, said main data being ciphered from said one of the original digital data groups, said main data and said cipher key being recorded on different layers each other, said reproduction apparatus comprising means for determining deciphering rules by reading said cipher key, and means for restoring said one of the original data groups from said main data by deciphering thereof according to said deciphering rules determined by said determining means, wherein said cipher key is reproduced by other readout means than readout means for said main data.

7. An optical recording medium comprising:

a plurality of layers of recorded digital data with at least one of said plurality of layers having digital data arranged as original digital data groups in a form of marks or pits readable by optical means,

said original digital data groups divided into a plurality of sub-data groups,

each of said plurality of sub-data groups containing main data and a cipher key,

said main data being ciphered from said one of the original digital data groups, and

said main data and said cipher key being recorded on different layers of said plurality of layers,

wherein said cipher key is recorded as a bar code.

8. A recording method of an optical recording medium, wherein said optical recording medium comprising a plurality of layers of recorded digital data with at least one of said plurality of layers having digital data arranged as original digital data groups in a form of marks or pits readable by optical means, said original digital data groups divided into a plurality of sub-data groups, each of said plurality of sub-data groups containing main data and a cipher key, said main data being ciphered from said one of the original digital data groups, and said main data and said cipher key being recorded on different layers of said plurality of layers, and wherein said recording method comprising a step of recording said cipher key as a bar code.

9. A reproduction apparatus for reproducing an optical recording medium having a plurality of layers of recorded data including at least one of original digital data groups, the recorded data being in a form of marks or pits readable by optical means, sub-data groups containing main data and a cipher key, said main data being ciphered from said one of the original digital data groups, said main data and said cipher key being recorded on different layers each other, said reproduction apparatus comprising means for determining deciphering rules by reading and cipher key, and means for restoring said one of the original data groups from said main data by deciphering thereof according to said deciphering rules determined by said determining means, wherein said cipher key is reproduced by one of optical bar code reader, a magnetic sensor and an electrostatic capacitance sensor.

* * * * *

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G11B 7/24
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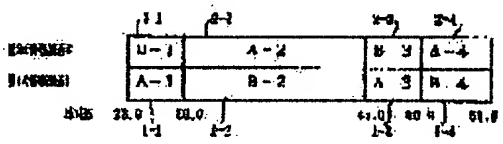
(72)Inventor : KONDO TETSUYA
NAGANO HIROBUMI

(54) OPTICAL RECORDING MEDIUM AND APPARATUS FOR REPRODUCING IT

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent an optical disc supplying software or music data from being copied while hardly increasing the cost of the optical disc.
SOLUTION: A digital signal data A or B representing one data of an image, music, a program, etc., is divided in two or more by a unit smaller than the recordable amount of data of one data-recording face. The data are recorded separately to two or more different data-recording faces, so that the data recorded to the data-recording faces are discontinuous. The data A and the data B are recorded to one data-recording face fragmentarily in a mixed state. Even when data-recording faces of an optical disc are totally copied, the data A and B are fragmentarily mixed and any of the data A and B forms a meaningless disc not fulfilling one complete single data. Accordingly, illegal copying can be prevented.



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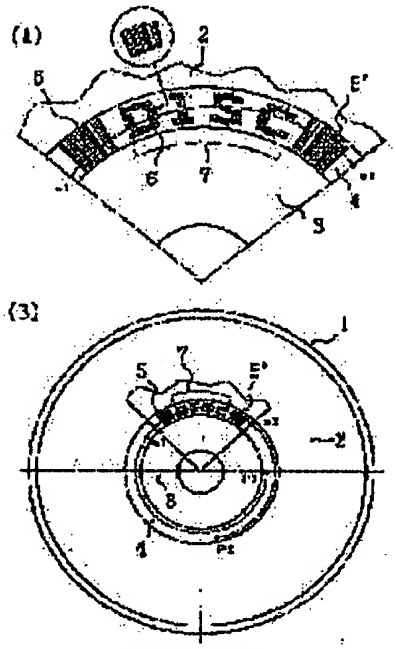
(22)Date of filing : 27.09.1996

(71)Applicant : VICTOR CO OF JAPAN LTD
(72)Inventor : OZAKI KAZUHISA

(54) OPTICAL DISK AND ITS REPRODUCING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To effectively prevent illegal copies of optical disks recorded with music software and game software, etc.
SOLUTION: A low density bar code symbols 5 and 5' and high density bar code symbols 6 are constituted by bar code elements formed as through holes in a radial pattern in a specular surface area 4 on the innermost circumferential side of the optical disk, and the high density bar code symbols 6 constitute a logotype part 7 by two-dimensionally arranging the plural symbols 6. The symbols 5 and 5' and the symbols 6 are shown as information of the same contents for discriminating the optical disk or information for obtaining identification information of the optical disk in a certain arithmetic algorithm by using both bar code symbols. When the identification information of the optical disk is obtained by confirming either of the symbols to be reasonable information and coincidence between the two symbols in their information in the former case, or by calculating the algorithm in the latter case, reproducing permission of main information of the optical disk is given as the legal disk by the reproducing device.



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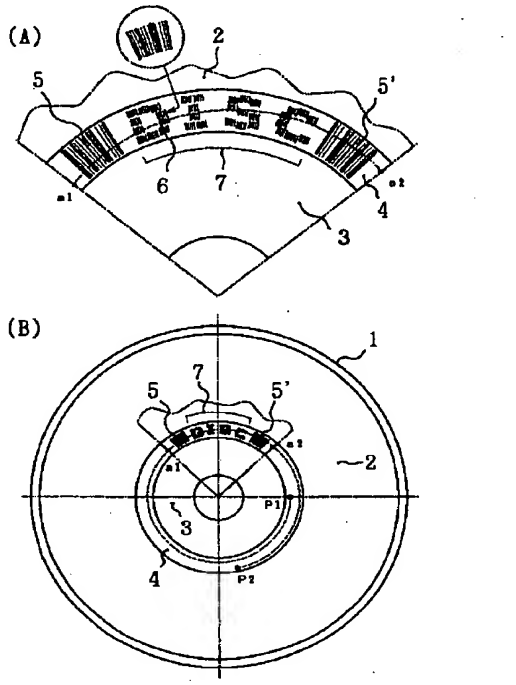
(54)【発明の名称】　光ディスク及びその再生装置

(57)【要約】

【課題】　音楽ソフトやゲームソフト等を記録した光ディスクの不正な複製を有効に防止する。

【解決手段】　光ディスクの最内周側の鏡面領域4に放射状の貫通孔として形成したバーコードエレメントで低密度バーコードシンボル5,5'と高密度バーコードシンボル6を構成し、高密度バーコードシンボル6は複数個を２元的に配置してロゴ部7を構成する。前記のシンボル5,5'とシンボル6は光ディスクを識別するための同一内容の情報か、又は双方を用いて一定の演算アルゴリズムで光ディスクの識別情報が求められる情報としておく。再生装置では、前者の場合には何れかのシンボルの情報の適正確認と両シンボルの情報の一致により、後者の場合には前記アルゴリズムの演算により光ディスクの識別情報が求まった場合に、光ディスクを正規なものとみなして主情報の再生許可を与える。



【特許請求の範囲】
【請求項１】　光ディスクにおいて、その主情報の記録領域以外であって光ピックアップで読取り可能な領域の反射層に、ディスクの中心から見て放射方向へ長い貫通孔として形成したバーコードエレメントでモジュール幅の広い低密度バーコードシンボルとモジュール幅の狭い高密度バーコードシンボルを構成し、前記の各バーコードシンボルはその光ディスクに係る同一内容の識別情報を有していると共に、高密度バーコードシンボルについてはそれを複数個用いて２次元的に配置させることにより視覚的に認識可能なキャラクタを構成したことを特徴とする光ディスク。
【請求項２】　光ディスクにおいて、その主情報の記録領域以外であって光ピックアップで読取り可能な領域の反射層に、ディスクの中心から見て放射方向へ長い貫通孔として形成したバーコードエレメントでモジュール幅の広い低密度バーコードシンボルとモジュール幅の狭い高密度バーコードシンボルを構成し、前記の各バーコードシンボルは双方の情報を用いた一定の演算アルゴリズムに基づいてその光ディスクの識別情報を与える情報を有していると共に、高密度バーコードシンボルについてはそれを２次元的に複数個配置させることにより視覚的に認識可能なキャラクタを構成したことを特徴とする光ディスク。
【請求項３】　請求項１の光ディスクを対象とした再生装置であって、光ディスクの主情報の再生に先立って、その光ディスクを回転させながら光ピックアップを低密度バーコードシンボルと高密度バーコードシンボルの構成領域へ移動させて各バーコードシンボルの信号の読取りを実行させる読取り制御手段と、前記読取り制御手段による制御過程で光ピックアップが読取った信号の内の低密度バーコードシンボルから得られた信号成分のみを通過させる第１フィルタ手段と、前記読取り制御手段による制御過程で光ピックアップが読取った信号の内の高密度バーコードシンボルから得られた信号成分のみを通過させる第２フィルタ手段と、前記第１フィルタ手段の出力信号に基づいてバーコードデータを作成する第１データ作成手段と、前記第２フィルタ手段の出力信号に基づいてバーコードデータを作成する第２データ作成手段と、前記の各データ作成手段が作成した各バーコードデータを記憶する記憶手段と、前記記憶手段が記憶した何れか一方のバーコードデータが正規の光ディスクに付与される識別データか否かを判別する判別手段と、前記記憶手段が記憶した双方のバーコードデータを比較する比較手段と、前記判別手段が正規の光ディスクに付与される識別データであることを判別し、且つ前記比較手段が双方のバーコードデータの一致を確認した場合にのみ光ディスクの主情報の再生許可を与える判定手段を具備したことを特徴とする光ディスクの再生装置。
【請求項４】　請求項２の光ディスクを対象とした再生装置であって、光ディスクの主情報の再生に先立って、その光ディスクを回転させながら光ピックアップを低密度バーコードシンボルと高密度バーコードシンボルの構成領域へ移動させて各バーコードシンボルの信号の読取りを実行させる読取り制御手段と、前記読取り制御手段による制御過程で光ピックアップが読取った信号の内の低密度バーコードシンボルから得られた信号成分のみを通過させる第１フィルタ手段と、前記読取り制御手段による制御過程で光ピックアップが読取った信号の内の高密度バーコードシンボルから得られた信号成分のみを通過させる第２フィルタ手段と、前記第１フィルタ手段の出力信号に基づいてバーコードデータを作成する第１データ作成手段と、前記第２フィルタ手段の出力信号に基づいてバーコードデータを作成する第２データ作成手段と、前記の各データ作成手段が作成した各バーコードデータを記憶する記憶手段と、前記記憶手段が記憶した各デコードデータを用いて前記光ディスクに対応した一定の演算アルゴリズムで識別データを演算する演算手段と、前記演算手段が求めた識別データが正規の光ディスクに付与される識別データか否かを判別する判別手段と、前記判別手段が正規の光ディスクに付与される識別データであることを判別した場合にのみ光ディスクの主情報の再生許可を与える判定手段を具備したことを特徴とする光ディスクの再生装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は光ディスク及びその再生装置に係り、特に音楽ソフトやゲームソフト等を記録した光ディスクが正規の製品か否かを厳密に確認し、著作権の侵害を構成する不正な複製を防止するための対策に関する。
【０００２】
【従来の技術】オーディオディスクであるＣＤ(Compact Disc)やテレビゲームの記録媒体に用いられている光ディスク、更には最近注目されている映像ディスクであるＤＶＤ(Digital Video Disc)は、その情報がディジタルデータで記録されているために多数回の複製によっても音質や映像の劣化がなく、アナログ記録の音楽磁気テープ等の記録媒体よりも不正な複製が横行し易い。特に、それらの光ディスクが「海賊版」と称される光ディスクとして複製されると、著作権者や出版社に多大な不利益をもたらすことになる。
【０００３】従って、著作権法でも特別な考慮が図られていると共に、出版社側では光ディスクのレーベル面や最内周側の鏡面領域に正規の製品であることを示す識別情報(製造ロット番号やシリアル番号等)を印刷･刻印して製造･出荷を管理することが行われている。。しかし、前記の識別情報を印刷や刻印によって行うのではその複製も容易であるため、光ディスクの製造に際して、その保護層を形成する前又は形成した後に、高出力レー

ザビームで鏡面領域の反射層にディスクの中心から見て放射方向へ長いバーコードエレメントとなる貫通孔を形成してバーコードシンボルを構成する方式が提案されている(特開平6-203412号)。また、本願出願人は、主情報を一定の符号化手段で記録しておくと共に、前記の鏡面領域等に主情報の復号化手段を示すキー情報をバーコードシンボルで記録しておき、再生装置がそのキー情報を読取ってその情報で示される復号化方式で主情報を復号化･再生する方式(特開平7-85574号)や、キー情報を主情報を構成するピットの変形態様で与えておき、そのキー情報を先に読取って復号化手段等を選択するという再生方式(特開平8-124219号)を提案している。

【０００４】尚、ソフトウェア製品の複製を防止する対策には、前記のような物理的手法が絡まない論理的手法のみによる対策もあるが、一般には物理的手法の方がより有効である。

【０００５】

【発明が解決しようとする課題】ところで、特開平6-203412号の方式による場合、従来のレーベル面への印刷や鏡面領域への刻印による方式よりも複製が困難になるが、高出力レーザビームを用いて幅の広いバーコードエレメントでバーコードシンボルを形成することは比較的簡単な設備で容易に行え、またその加工コストも安価である。従って、それだけに複製が容易であり、実際面で光ディスクの複製に対してどれだけ有効な防止効果があるかは疑問である。

【０００６】一方、特開平7-85574号や特開平8-124219号の方式は、キー情報の形成の困難性と共に再生装置側が関係して再生の可／不可を決定させるため、セキュリティを高めたより有効な対策になることは評価できるが、バーコードや変形ピットは情報の内容を視覚的に直接認識させるものでなく、実用上で不便な場合が多くなる。また、特開平7-85574号の方式は、特開平6-203412号の場合と同様にバーコードシンボルの形成が比較的容易であるためにその有効性が失われてしまい、特開平8-124219号の方式では、ピットの変形という特殊な方式を採用しているために極めて高いセキュリティ機能を実現できるが、ディスクの製造段階又は製造後に極めて微細なピットを変調するための複雑で高度な技術を必要とし、高価な設備が必要になると共に歩留まりの低下を避けられない。

【０００７】そこで、本発明は、ディスクの識別情報を前記のバーコードシンボルで記録すると共に、更にロゴマークや数字等でカモフラージュさせた微細なバーコードシンボルを記録しておくことにより、再生装置側の構成と共働して光ディスクの不正な複製を困難にし、その有効な防止対策を提供することを目的として創作された。

【０００８】

【課題を解決するための手段】第１の発明は、光ディスクにおいて、その主情報の記録領域以外であって光ピックアップで読取り可能な領域の反射層に、ディスクの中心から見て放射方向へ長い貫通孔として形成したバーコードエレメントでモジュール幅の広い低密度バーコードシンボルとモジュール幅の狭い高密度バーコードシンボルを構成し、前記の各バーコードシンボルはその光ディスクに係る同一内容の識別情報を有していると共に、高密度バーコードシンボルについてはそれを複数個用いて２次元的に配置させることにより視覚的に認識可能なキャラクタを構成したことを特徴とする光ディスクに係る。

【０００９】そして、その光ディスクの再生に際しては、主情報の再生に先立って、光ディスクを回転させながら光ピックアップを低密度バーコードシンボルと高密度バーコードシンボルの構成領域へ移動させて各バーコードシンボルの信号の読取りを実行させる読取り制御手段と、前記読取り制御手段による制御過程で光ピックアップが読取った信号の内の低密度バーコードシンボルから得られた信号成分のみを通過させる第１フィルタ手段と、前記読取り制御手段による制御過程で光ピックアップが読取った信号の内の高密度バーコードシンボルから得られた信号成分のみを通過させる第２フィルタ手段と、前記第１フィルタ手段の出力信号に基づいてバーコードデータを作成する第１データ作成手段と、前記第２フィルタ手段の出力信号に基づいてバーコードデータを作成する第２データ作成手段と、前記の各データ作成手段が作成した各バーコードデータを記憶する記憶手段と、前記記憶手段が記憶した何れか一方のバーコードデータが正規の光ディスクに付与される識別データか否かを判別する判別手段と、前記記憶手段が記憶した双方のバーコードデータを比較する比較手段と、前記判別手段が正規の光ディスクに付与される識別データであることを判別し、且つ前記比較手段が双方のバーコードデータの一致を確認した場合にのみ光ディスクの主情報の再生許可を与える判定手段を具備した再生装置が適用される。

【００１０】第１の発明の光ディスクでは、主情報の記録領域以外であって光ピックアップで読取り可能な領域の反射層に対して、従来技術に示されているような低密度バーコードシンボルに加えて、キャラクタ(文字･図形･記号)として視覚的に認識される態様で複数個の高密度バーコードシンボルを２次元的に配置させている。従って、前記のキャラクタを光ディスクに固有の識別情報等を示す文字等で構成すれば、その情報を視覚的に直接確認させることができ、実用上の便宜が図れる。また、キャラクタ内に高密度バーコードシンボルがカモフラージュされているためにその存在の発見が困難であり、もし発見されたとしても、高密度で２次元配置されているために完全な模倣を行うことは技術的に極めて困難である。そのため、不正な複製品では、低密度バーコードシ

ンボルを形成していてもキャラクタを高密度バーコードシンボルで構成できず、正規の光ディスクとの相違を確認することが容易になる。

【００１１】また、再生装置では低密度バーコードシンボルと高密度バーコードシンボルの一致を再生許可条件とするために高密度バーコードシンボルが第２のセキュリティー情報としての役割を果たし、キャラクタ表現態様で配置された高密度バーコードシンボルも完全に複製していなければ再生不能な光ディスクとなるため、不正な複製品の実用性を失わせることができる。

【００１２】第２の発明は、前記の第１の発明の光ディスクにおける低密度バーコードシンボルと高密度バーコードシンボルの情報を、双方の情報を用いた一定の演算アルゴリズムに基づいてその光ディスクの識別情報を与える内容としたものである。例えば、一方のバーコードシンボルの情報の解読キーを他方のバーコードシンボルの情報が与えるというように暗号化された情報内容を持たせることができる。

【００１３】そして、その光ディスクの再生に際しては、第１の発明と同様の機能手段である読取り制御手段と第１フィルタ手段と第２フィルタ手段と第１データ作成手段と第２データ作成手段と記憶手段とを具備すると共に、その光ディスクの主情報再生の許可／不許可を判定するために、前記記憶手段が記憶した各デコードデータを用いて前記光ディスクに対応した一定の演算アルゴリズムで識別データを演算する演算手段と、前記演算手段が求めた識別データが正規の光ディスクに付与される識別データか否かを判別する判別手段と、前記判別手段が正規の光ディスクに付与される識別データであることを判別した場合にのみ光ディスクの主情報の再生許可を与える判定手段を具備した再生装置が適用される。

【００１４】この第２の発明によれば、低密度バーコードシンボルと高密度バーコードシンボルが同一内容のシンボルパターンとならないために光ディスクの複製がより困難になり、また暗号化された情報を用いた一定の演算アルゴリズムに基づいて光ディスクの識別データが求められるため、第１の発明の場合より更にセキュリティー機能を向上させることができる。

【００１４】

【発明の実施の形態】以下、本発明の光ディスク及びその再生装置の実施形態を図面を用いて詳細に説明する。

《実施形態１》先ず、図１は実施形態に係る光ディスクの読取り側面の平面図(B)とその要部の拡大図(A)を示す。同図において、1は光ディスクであり、その主情報の記録領域2のリードイン部の内側でクランパ領域3の外側に相当する領域には環状の鏡面領域4が構成されている。ここに、前記の鏡面領域4は、光ディスク1における透明プラスチック層(カーボネイト層)と保護層の間に介装されている反射層(アルミニウム等の金属層)からなる反射層に主情報が記録されておらず、鏡面状の反射面として構成されている。

【００１５】この実施形態では、鏡面領域4の反射層に対して一定の中心角を隔てて２個の低密度バーコードシンボル5,5'が形成されており、それらの間には前記のバーコードシンボル5,5'と比較してその幅と高さが約１／４になっている高密度バーコードシンボル6を２次元的に多数個配置形成し、周方向に「DISC」の文字列を構成したロゴ部7が構成されている。また、この実施形態では低密度バーコードシンボル5,5'と高密度バーコードシンボル6の各バーコードエレメントは光ディスクの中心から見て放射方向へ長く形成されていると共に、双方とも光ディスク1の識別情報を表す同一のシンボルパターンを有している。更に、低密度バーコードシンボル5,5'と高密度バーコードシンボル6はそれぞれのサイズに対応した比のモジュール幅を有し、必然的にワイドバーとナローバーの幅及びワイドスペースとナロースペースの幅もその対応比になっている。

【００１６】そして、前記の低密度バーコードシンボル5,5'とロゴ部7を施した一部分を鏡面領域4の半径方向に係る幅の略中心を通る周方向断面で見ると図２のようになっている。同図において、10はカーボネイト層、11は保護層であり、それらの層間に反射層12が介装されているが、反射層12は低密度バーコードシンボル5に相当するバーコード部と高密度バーコードシンボル6に相当するロゴ部が鏡面部13を介して連続した態様になる。ここに、低密度バーコードシンボル5,5'及び各高密度バーコードシンボル6は、上記の特開平6-203412号の方式で、この光ディスク1の製造過程で保護層11を施す前又は施した保護層11を硬化させる前に高出力レーザビームを反射層12に集光させてそのアルミニウム層に貫通孔を形成することにより構成されている。従って、バーコードシンボルのバーエレメントに相当する貫通孔の部分では光が反射せず、スペースエレメントに相当するアルミニウム部分は鏡面部13と同等の反射率で光を反射させる。

【００１７】ところで、ロゴ部7は前記のように多数の高密度バーコードシンボル6を２次元的に配置させて構成されているが、図１(B)に示すように視覚的には周囲の鏡面と比較して少し暗く見える態様でロゴ:「DISC」のロゴが描かれているようにしか見えず、顕微鏡等で詳細に見なければそのロゴ面が高密度バーコードシンボル6で構成されていることを認識できない。

【００１８】そして、前記の光ディスク1は図３に示す再生装置で再生される。但し、図３のシステム回路は主に再生装置におけるディスク確認に関連した部分のシステム回路であり、それ以外の部分は省略されている。同図において、21は光ピックアップ、22はスピンドルモータ、23はスピンドル・トラッキング制御等を実行するサーボ回路、24は光ピックアップ21に対するアクチュエータドライバ、25は光ピックアップ21の検出信号を増幅する光量検出アンプ、26はアンプ、27は低密度バーコード

シンボル5,5'から得られる光検出信号成分のみを通過させるローパスフィルタ（ＬＰＦ）、28は閾値電圧をＶtbとしてＬＰＦ27の出力信号を２値化するコンパレータ、29はコンパレータ28の出力データをデコードするデコーダ、30はアンプ、31は高密度バーコードシンボル6から得られる光検出信号成分のみを通過させるバンドパスフィルタ（ＢＰＦ）、32は閾値電圧をＶt1としてＢＰＦ31の出力信号を２値化するコンパレータ、33はコンパレータ32の出力データをデコードするデコーダ、34は再生装置のシステム全体を統括的に制御すると共にディスク確認モードにおいてセットされた光ディスク1の再生の許可／不許可を判定するマイクロコンピュータ回路（以下「マイコン回路」という）である。

【００１９】次に、前記のシステム回路において光ディスク1を再生する際の動作手順を図１１のフローチャートを用いて説明する。また、その説明の過程で必要に応じて図１から図１０を用いる。図３において、マイコン回路34に対して光ディスク1の再生指示がなされると、そのＣＰＵはＲＯＭに格納されている制御プログラムに基づいて、以下の手順を実行する。先ず、再生指示によってディスク確認モードを設定し、直ちにサーボ回路23へ同モードでの制御データを出力する（S1～S3）。そして、サーボ回路23はスピンドルモータ22を起動させて光ディスク1を３６０° 以上回転させ、その回転過程で光ピックアップ21を光ディスク1の環状の鏡面領域4の半径方向の幅に相当する距離分だけ移動させる（S4）。

【００２０】この制御時における光ディスク1の回転速度と光ピックアップ21の移動位置との時系列的変化は図４に示される。即ち、光ディスク1の回転は急激に立上げられて定速状態へ移行し、ほぼ約１回転する時間帯はその定速状態を保ち、１回転した後に立下げられて停止する。また、光ピックアップ21は初期位置Ｐ1から最終位置Ｐ2まで移動しているが、光ディスク1が定速状態へ移行した時には等速度で外側へ移動し、光ディスク1が定速回転し、光ピックアップ21が等速移動している時間帯が低密度バーコードシンボル5,5'とロゴ部7の読取り時間に対応している。従って、光ディスク1の読取り側面に対する光ピックアップ21の相対的な移動軌跡は図１（B）で点線で示したＰ1～Ｐ2となって、光ピックアップ21は必ず低密度バーコードシンボル5,5'とロゴ部7を横切ることになり、少なくとも点ａ1～ａ2の軌跡部分では光ディスク1が定速回転し、光ピックアップ21が等速移動していることになる。

【００２１】ところで、前記の読取り時間帯で、光ピックアップ21が低密度バーコードシンボル5とロゴ部7の最初の高密度バーコードシンボル6を横切った際の出力信号（読取り信号）は図５のような信号波形となる。即ち、図２を対応させれば明らかなように、当然に低密度バーコードシンボル5の部分での読取り信号は長い周期の信号波形になり、高密度バーコードシンボル6の部分では短い周期の信号波形になるが、上記のように双方のシンボル5,6は同一のパターンを有しているために、時間軸方向に粗密の関係になっているだけで信号内容は同一である。

【００２２】そして、前記の読取り信号は光量検出アンプ25からアンプ26を介してＬＰＦ27へ入力され、また光量検出アンプ25からアンプ30を介してＢＰＦ31へ入力されるが、ＬＰＦ27は低密度バーコードシンボル5に係る信号成分のみを通過させて図６に示すような信号を出力し、ＢＰＦ31は高密度バーコードシンボル6に係る信号成分のみを通過させるために図７に示すような信号波形を出力する。より詳細には、ＬＰＦ27とＢＰＦ31は図８の点線で示すような周波数特性を有しており、それぞれ通過帯域に低密度バーコードシンボル5に係る信号のスペクトラムと高密度バーコードシンボル6に係る信号のスペクトラムを含んでいる。

【００２３】次に、各フィルタ27,31の出力はそれぞれコンパレータ28,32へ入力されるが、コンパレータ28は図６の信号波形のＰ-Ｐ値のほぼ中間に閾値電圧Ｖtbを、コンパレータ32は図７の信号波形のＰ-Ｐ値のほぼ中間に閾値電圧Ｖt1を設定しており、各フィルタ27,31の出力信号を２値化する。従って、コンパレータ28の出力信号は図９に、コンパレータ10の出力信号は図１０に示すパルス波形となる。

【００２４】そして、前記の各パルス波形は各コンパレータ28,32に対応して設けられているデコーダ29,33へ入力され、各デコーダ29,33はマイコン回路34が処理し得るデータストリームへデコードしてそれぞれマイコン回路34へ出力する。

【００２５】ここで、図１１のフローチャートへ戻って、各デコードデータを受信したマイコン回路34ではそれをＩ/Ｏポートから取込み、各データを内蔵ＲＡＭに格納する（S5）。尚、図５から図７及び図９と図１０では１個の低密度バーコードシンボル5とその次に読取られる高密度バーコードシンボル6の信号のみを対象にしているが、実際には図１に示されるように光ピックアップ21は１個の低密度バーコードシンボル5を読取った後、ロゴ部7で多数個の高密度バーコードシンボル6を読取り、更に１個の低密度バーコードシンボル5を読取ることになるため、低密度バーコードシンボル5に係るデコードデータが２セット、高密度バーコードシンボル6に係るデコードデータが多数セット分にわたってＲＡＭに格納されることになる。そして、それらのデコードデータが全て格納された後に光ディスク1の回転が停止せしめられ、また光ピックアップ21が初期位置へ戻される（S6）。

【００２６】次に、マイコン回路34はＲＡＭに格納した低密度バーコードシンボル5に係るデコードデータと予めＲＯＭに格納されている識別データを比較する（S7）。この実施形態においては、ＲＯＭの識別データをこの光

ディスクに付与され得るシリアル番号とロット番号の許容範囲データとして与えており、光ディスク1が正規の製品であれば、前記の各バーコードシンボル5,6が表現するデータがその許容範囲データに含まれることになる。従って、低密度バーコードシンボル5に係るデコードデータがＲＯＭの識別データが示す範囲内に含まれていれば、この光ディスク1が正規の製品であろうと推定できる。しかし、マイコン回路34はその条件が満たされていることが確認できても判断を留保し、更にＲＡＭに格納した低密度バーコードシンボル5と高密度バーコードシンボル6に係る各デコードデータが一致するかを確認する(S8)。そして、その一致も確認された段階でこの光ディスク1が正規のものであると判断し、当初に設定したディスク確認モードを解除して本来の再生モードへ移行させる(S8→S13)。

【００２７】このように、光ディスク1の正規性を最終的に確定するまでに、Ｓ７とＳ８の２つの確認条件を課していることは、次のような意義を有している。先ず、Ｓ７の確認条件は低密度バーコードシンボル5で正確にこの光ディスク1に付与され得るシリアル番号とロット番号が表現されているかを確認するものであり、そのようなバーコードシンボル5が付されていないか又は許容できるシリアル番号等が正確に表現されていない場合には不正に複製された光ディスクであるということになる。しかし、低密度バーコードシンボル5を形成することは安価な製造設備で容易に行うことができるため、不正に複製された光ディスクであっても複製対象とした正規の光ディスクの低密度バーコードシンボル5をそのまま形成しておけばＳ７の確認条件をクリアでき、不正な複製品を排除するための有効性が失われる。これに対して、Ｓ８の確認条件をクリアするためには、上記のように「DISC」のロゴにカモフラージュされた高密度バーコードシンボル6を見つけ出し、設備の改造や高度な技術を必要とする高密度バーコードシンボル6の形成を行わねばならず、殆どの不正な複製品はこの条件をクリアできないことになる。即ち、二重の条件で不正な複製に対するセキュリティを飛躍的に向上させることができる。

【００２８】そして、この実施形態では、Ｓ７の条件を満たさなかった場合、及びそれを満たしてもＳ８の条件を満たさなかった場合には、直ちにＲＡＭの格納データをクリアしてＳ３～Ｓ９の手順を再実行させ(S7～S10→S3)、更にその手順を３回繰り返し実行してもＳ７とＳ８での確認条件をクリアできない時には、マイコン回路34が光ディスク1を完全に不正な複製品であるとみなし、再生不許可の表示制御信号を出力すると共に、その光ディスク1の排出動作を実行させて今回のディスク確認モードを抜ける(S10～S12)。尚、Ｓ３～Ｓ９の手順を３回実行させているのは、最終確定の慎重を期するためである。

【００２９】また、システムの信頼性を向上させるためには次のような対策を施しておくことも有効である。

(1) ＲＡＭに多数の低密度バーコードシンボル5と高密度バーコードシンボル6に係るデコードデータが格納されるため、全てのデコードデータを比較対象として用い、一定以上の一致条件が得られた場合にのみ正規の光ディスクとみなすような処理手順を実行させる。

(2) 鏡面領域4にはその周方向にスペースの余裕を見込めるため、各バーコードシンボル5,5',6の前後のクワイエットゾーンを大きくとることによって読取りエラーを少なくする。

【００３０】更に、この実施形態では、光ディスク1の低密度バーコードシンボル5,5'とロゴ部7の高密度バーコードシンボル6が常にほぼ同一半径上で現れるような配置態様になっているが、両者が別の半径上に位置しているようにしてもよい。また、この実施形態は、光ディスクであって鏡面領域4に相当する領域を有するものであればその種類を問わず適用でき、代表的な光ディスクであるＣＤだけでなく、ミニディスクや２面張り合わせのＭＯディスクやＤＶＤ-ＲＯＭ等の多種多様な光ディスクに適用できる。

【００３１】《実施形態２》この実施形態の特徴は、①前記の実施形態１における光ディスク1の低密度バーコードシンボル5,5'とロゴ部7の高密度バーコードシンボル6が同一内容の情報を有していたのに対し、低密度バーコードシンボル5,5'が光ディスク1の識別情報を暗号化した内容の情報を有しており、高密度バーコードシンボル6がその暗号化された情報を解読するためのキー情報としての内容を有している点、及び②再生装置において各バーコードシンボル5,5',6の情報を前記の内容としたことにより光ディスク1を判定するための手順が異なる点にある。尚、この実施形態では光ディスクの識別情報を簡単なコード情報で与えることとしている。

【００３２】従って、光ディスク1についてみると、実施形態１に係る図１では低密度バーコードシンボル5,5'と高密度バーコードシンボル6にモジュールの粗密があるだけでシンボルパターンは同一になっているが、この実施形態では各バーコードシンボル(5,5'),6のシンボルパターンが相違し、それに対応して図２における反射層12の断面の態様が異なることになる。また、再生装置についてみると、図３に示したシステム回路の基本構成自体は同様であるが、前記のように２種のバーコードシンボル(5,5'),6の情報内容が異なるため、実施形態１においてシステムの動作説明のために用いた図５から図７及び図９と図１０の各信号波形が異なることになる。

【００３３】そして、この実施形態の特徴は図１２のフローチャートによって具体的に説明される。先ず、同図におけるＳ２１～Ｓ２６の制御シーケンスは実施形態１の場合と同様であり、それらの手順は実施形態１における図１１のＳ１～Ｓ６に対応している。ところで、Ｓ２６までの手順が完了すると、マイコン回路34のＲＡＭに

は低密度バーコードシンボル5,5'とロゴ部7の高密度バーコードシンボル6に係る各デコードデータが格納されている(S25)。

【００３４】この実施形態では、ＣＰＵが高密度バーコードシンボル6に係るデコードデータを解読キーとして低密度バーコードシンボル5のデコードデータを解読し、その解読結果として光ディスク1に係る識別情報が求まる(S27)。即ち、低密度バーコードシンボル5のデータは暗号化されており、高密度バーコードシンボル6のデータがその暗号化アルゴリズムを解読するプログラムの指定コードを与え、ＣＰＵは予めＲＯＭに格納してある前記指定コードに対応した解読プログラムを読出して低密度バーコードシンボル5のデコードデータを解読する。

【００３５】また、マイコン回路34のＲＯＭにはこの再生装置が再生可能な光ディスク1に係る識別情報の付与範囲を示すデータが格納されている。そこで、ＣＰＵは先に得られた解読結果がＲＯＭのデータが示す範囲内に含まれているか否かを確認し、範囲内であればディスク確認モードを解除して本来の再生モードへ移行する(S28→S33)。一方、前記の確認において、解読結果が範囲外になった場合には、ＣＰＵはＲＡＭのデータをクリアしてＳ２３～Ｓ２９の手順を再実行させ(S30→S23～S29)、結果的にその手順を３回繰り返し実行しても確認結果が範囲外になった時には、が光ディスク1を完全に不正な複製品であるとみなし、再生不許可の表示制御信号を出力すると共に、その光ディスク1の排出動作を実行させて今回のディスク確認モードを抜ける(S30～S32)。

【００３６】この実施形態によれば、暗号化データとその解読キーを各バーコードシンボル5,5',6で与えるようにしているため、光ディスク1を再生できる再生装置を限定することができ、また低密度バーコードシンボル5,5'とロゴ部7の高密度バーコード6を異なるシンボルパターンで構成しなければならないために、その複製がより困難になる。尚、この実施形態では、低密度バーコードシンボル5側のデータを暗号化データとし、高密度バーコードシンボル6側のデータをその暗号化データの解読キーとしているが、逆の関係でデータを持たせてもよい。更には、暗号化データと解読キーの組合せとせず、双方のデータを変数とした何らかの関数によって光ディスク1の識別情報が求められるようにしてもよい。

【００３７】

【発明の効果】本発明の光ディスク及びその再生装置は、以上の構成を有していることにより、次のような効果を奏する。請求項１の発明は、従来技術のように光ディスクの鏡面領域に対してその識別情報を低密度バーコードシンボルで施すことは比較的容易に複製できるが、この発明では低密度バーコードシンボルに加えて高密度バーコードシンボルを２次元的にキャラクタ構成態様で配設させるようにしているため、比較的安価な設備を用いて実現できるものの高度の製造技術を必要とし、不正な複製を極めて困難にして有効な複製防止対策を提供する。また、キャラクタをロゴマークやシリアル番号等にしてディスクの識別情報を視覚的に直接確認させることができると共に、キャラクタ内に高密度バーコードシンボルがカモフラージュされるために高密度バーコードシンボルの存在を発見し難くすることができる。請求項２の発明は、低密度バーコードシンボルと高密度バーコードシンボルの情報を用いて一定の演算アルゴリズムで光ディスクの識別情報を与えるようにしているため、再生装置側と共働して不正な複製に対するセキュリティ機能を更に高める。請求項３及び請求項４の発明は、それぞれ請求項１，２の光ディスクを対象とした再生装置として、それらの請求項１，２で規定される光ディスク以外の光ディスクに対する再生を不許可とし、音楽ソフトやゲームソフト等の不正な複製を無効化する。また、低密度バーコードシンボルだけで複製防止対策を施した光ディスクが普及したとしても、再生の許可／不許可を判定するためのプログラムをディップスイッチ等で切換えるだけで対応させることが可能であり、ハードウェアの変更を伴わずに互換性を確保させることができるという利点も有している。

【図面の簡単な説明】

【図１】本発明の実施形態に係る光ディスクの読取り側面の平面図(B)とその要部の拡大図(A)である。

【図２】低密度バーコードシンボルとロゴ部を施した一部分を鏡面領域の半径方向に係る幅の略中心を通る周方向断面で見た断面図である。

【図３】光ディスクの再生装置のシステム回路図である。

【図４】ディスク確認モードにおける光ディスクの回転速度と光ピックアップの移動位置の時系列的変化を示すグラフである。

【図５】ディスク確認モードにおける光ピックアップの出力信号を示すグラフである。

【図６】ＬＰＦの出力信号を示すグラフである。

【図７】ＢＰＦの出力信号を示すグラフである。

【図８】ＬＰＦとＢＰＦの周波数特性及び低密度バーコードシンボルと高密度バーコードシンボルに係る信号のスペクトラムを示すグラフである。

【図９】コンパレータ(バーコード部側)の出力信号を示すグラフである。

【図１０】コンパレータ(ロゴ部側)の出力信号を示すグラフである。

【図１１】実施形態１における再生装置のディスク確認モードでの動作手順を示すフローチャートである。

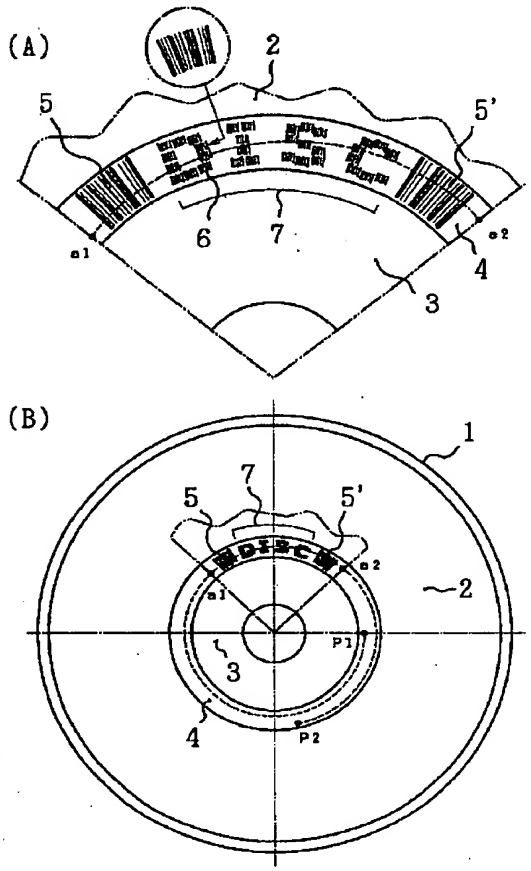
【図１２】実施形態２における再生装置のディスク確認モードでの動作手順を示すフローチャートである。

【符号の説明】

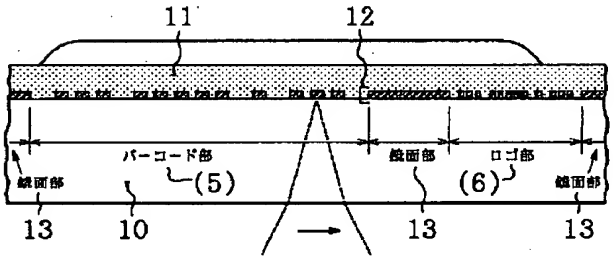
1…光ディスク、2…主情報の記録領域、3…クランパ領

域、4…鏡面領域、5,5'…低密度バーコードシンボル、6…高密度バーコードシンボル、7…ロゴ部、10…カーボネイト層、11…保護層、12…反射層、13…鏡面部、21…光ピックアップ、22…スピンドルモータ、23…サーボ回路、24…アクチュエータドライバ、25…光量検出アンプ、26,30…アンプ、27…ＬＰＦ、28,32…コンパレータ、29,33…デコーダ、31…ＢＰＦ、34…マイコン回路。

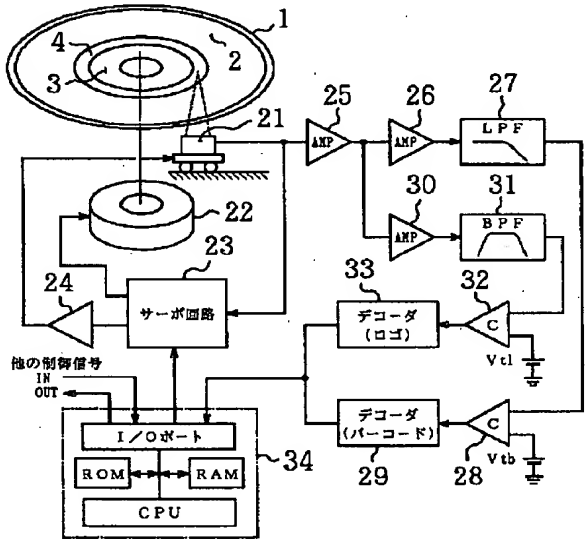
【図１】



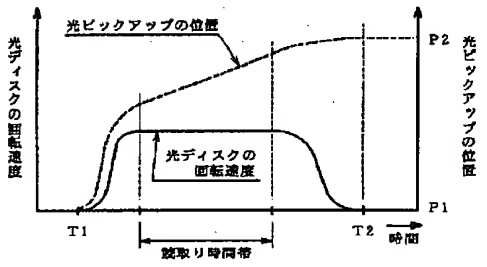
【図２】



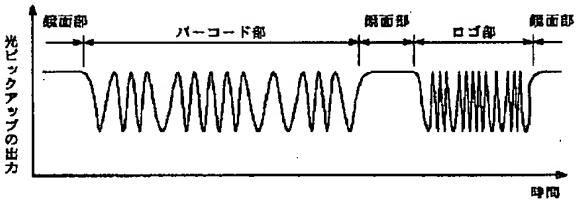
【図３】



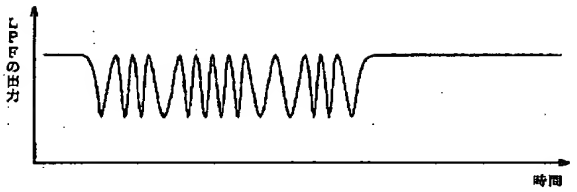
【図４】



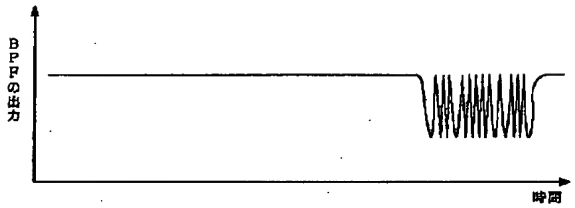
【図５】



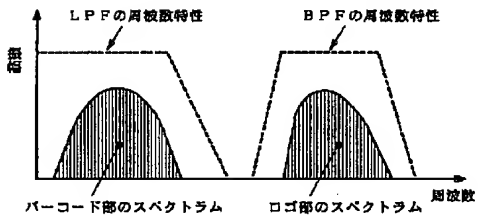
【図6】



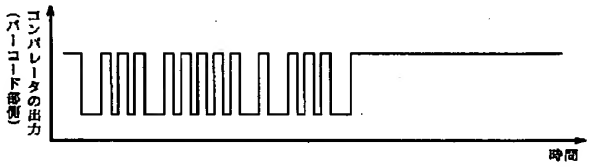
【図7】



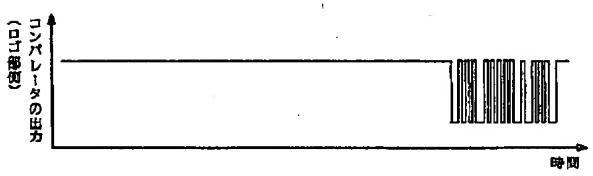
【図8】



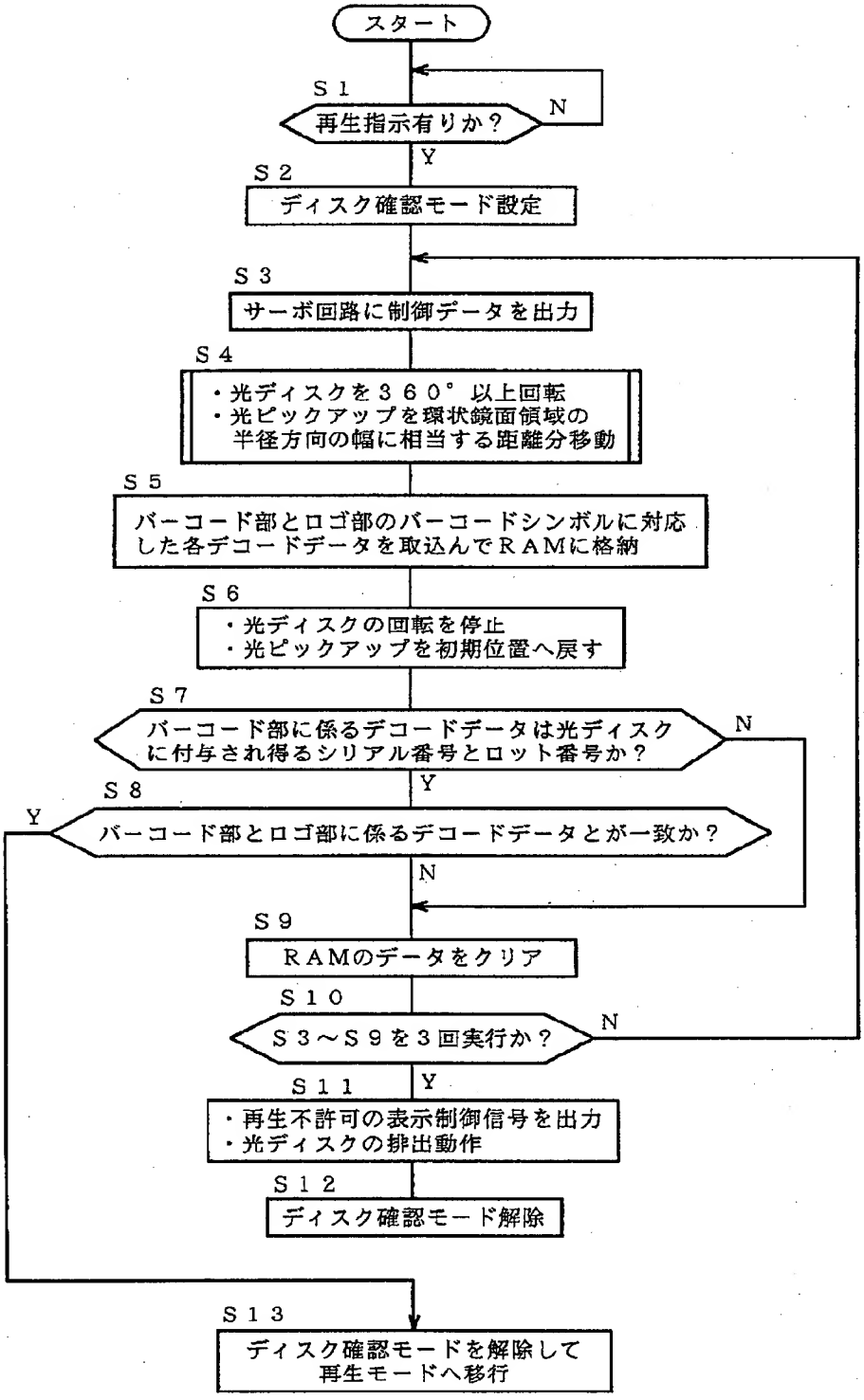
【図9】



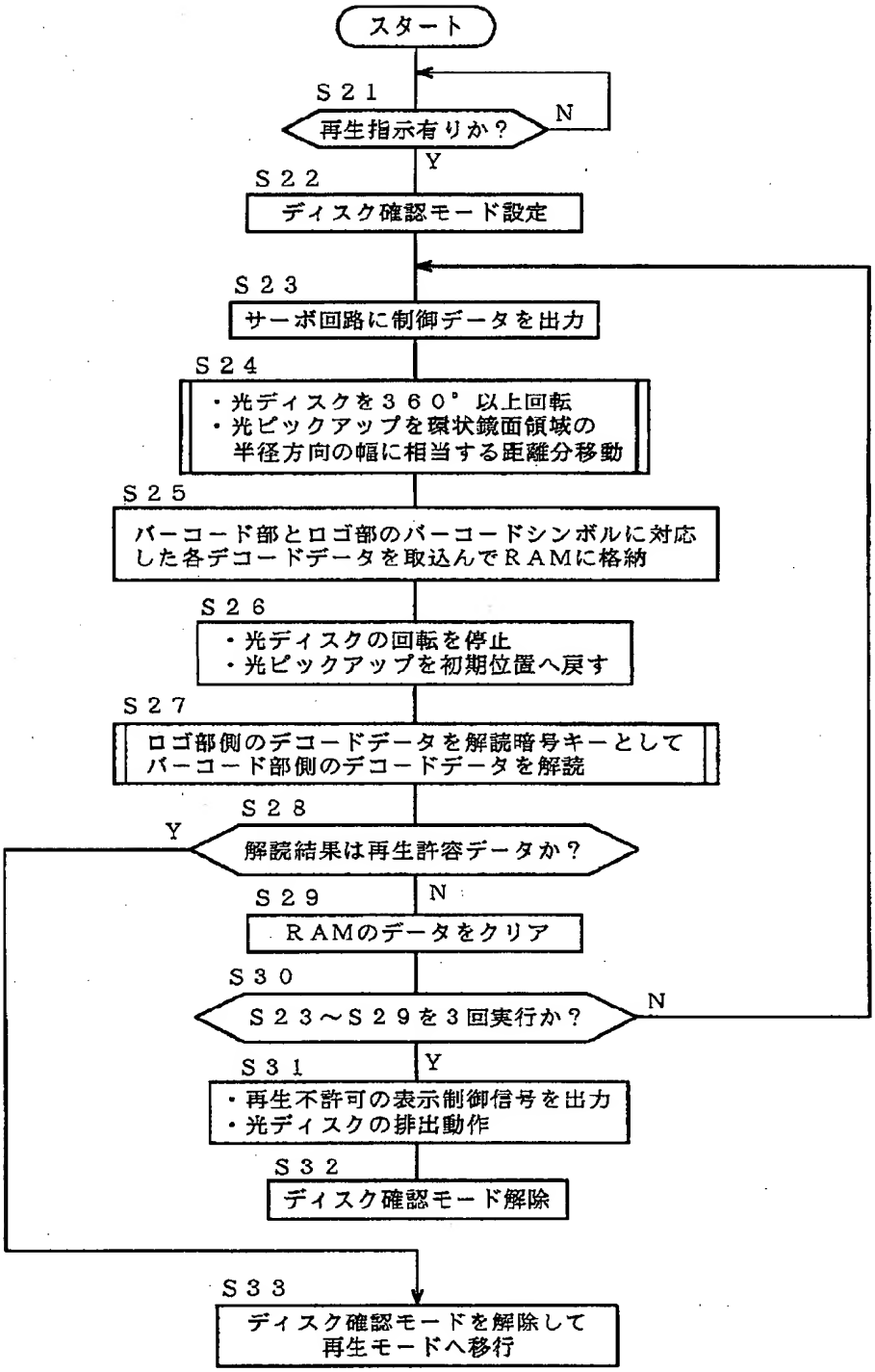
【図10】



【図11】


スタート
S1
再生指示有りか？
N
Y
S2
ディスク確認モード設定
S3
サーボ回路に制御データを出力
S4
・光ディスクを360°以上回転
・光ピックアップを環状鏡面領域の半径方向の幅に相当する距離分移動
S5
バーコード部とロゴ部のバーコードシンボルに対応した各デコードデータを取込んでRAMに格納
S6
・光ディスクの回転を停止
・光ピックアップを初期位置へ戻す
S7
バーコード部に係るデコードデータは光ディスクに付与され得るシリアル番号とロット番号か？
N
Y
S8
バーコード部とロゴ部に係るデコードデータとが一致か？
Y
N
S9
RAMのデータをクリア
S10
S3～S9を3回実行か？
N
Y
S11
・再生不許可の表示制御信号を出力
・光ディスクの排出動作
S12
ディスク確認モード解除
S13
ディスク確認モードを解除して再生モードへ移行

【図12】


スタート
S21
再生指示有りか？
N
Y
S22
ディスク確認モード設定
S23
サーボ回路に制御データを出力
S24
・光ディスクを360°以上回転
・光ピックアップを環状鏡面領域の半径方向の幅に相当する距離分移動
S25
バーコード部とロゴ部のバーコードシンボルに対応した各デコードデータを取込んでRAMに格納
S26
・光ディスクの回転を停止
・光ピックアップを初期位置へ戻す
S27
ロゴ部側のデコードデータを解読暗号キーとしてバーコード部側のデコードデータを解読
S28
Y
解読結果は再生許容データか？
N
S29
RAMのデータをクリア
S30
S23～S29を3回実行か？
N
Y
S31
・再生不許可の表示制御信号を出力
・光ディスクの排出動作
S32
ディスク確認モード解除
S33
ディスク確認モードを解除して再生モードへ移行

[JP,10-105974,A]

CLAIMS

[Claim(s)]

[Claim 1] In an optical disk, it is except the record section of the main information. By the optical pickup to the reflecting layer of the field in which read is possible A low consistency bar code symbol with wide module width of face and a high density bar code symbol with narrow module width of face are constituted from a bar code element which looked at from the core of a disk and was formed in the radiation direction as a long through tube. Each aforementioned bar code symbol is an optical disk characterized by constituting visually the character which can be recognized by making it arrange two-dimensional about a high density bar code symbol, using it two or more while having the identification information of the same contents concerning the optical disk.

[Claim 2] In an optical disk, it is except the record section of the main information. By the optical pickup to the reflecting layer of the field in which read is possible A low consistency bar code symbol with wide module width of face and a high density bar code symbol with narrow module width of face are constituted from a bar code element which looked at from the core of a disk and was formed in the radiation direction as a long through tube. While each aforementioned bar code symbol has the information which gives the identification information of the optical disk based on the fixed operation algorithm which used both information It is the optical disk characterized by constituting visually the character which can be recognized by arranging two or more them two-dimensional about a high density bar code symbol.

[Claim 3] Are a regenerative apparatus for the optical disk of claim 1, and playback of the main information on an optical disk is preceded. The read control means which moves an optical pickup to the configuration field of a low consistency bar code symbol and a high density bar code symbol, and performs read of the signal of each bar code symbol while rotating the optical disk, A 1st filter means to pass only the signal component obtained from the low consistency bar code symbol of the signals which the optical pickup read in the control process by said read control means, A 2nd filter means to pass only the signal component obtained from the high density bar code symbol of the signals which the optical pickup read in the control process by said read control means, A 1st data origination means to create bar code data based on the output signal of said 1st filter means, A 2nd data origination means to create bar code data based on the

output signal of said 2nd filter means, A storage means to memorize each bar code data which each aforementioned data origination means created, A distinction means to distinguish whether it is discernment data with which one which said storage means memorized of bar code data is given to the optical disk of normal, A comparison means to compare both bar code data that said storage means memorized, The regenerative apparatus of the optical disk characterized by providing a judgment means to give playback authorization of the main information on an optical disk only when it distinguishes that it is discernment data with which said distinction means is given to the optical disk of normal and said comparison means checks coincidence of both bar code data.

[Claim 4] Are a regenerative apparatus for the optical disk of claim 2, and playback of the main information on an optical disk is preceded. The read control means which moves an optical pickup to the configuration field of a low consistency bar code symbol and a high density bar code symbol, and performs read of the signal of each bar code symbol while rotating the optical disk, A 1st filter means to pass only the signal component obtained from the low consistency bar code symbol of the signals which the optical pickup read in the control process by said read control means, A 2nd filter means to pass only the signal component obtained from the high density bar code symbol of the signals which the optical pickup read in the control process by said read control means, A 1st data origination means to create bar code data based on the output signal of said 1st filter means, A 2nd data origination means to create bar code data based on the output signal of said 2nd filter means, A storage means to memorize each bar code data which each aforementioned data origination means created, An operation means to calculate discernment data with the fixed operation algorithm corresponding to said optical disk using each decoding data which said storage means memorized, A distinction means to distinguish whether it is discernment data with which the discernment data for which said operation means asked are given to the optical disk of normal, The regenerative apparatus of the optical disk characterized by providing a judgment means to give playback authorization of the main information on an optical disk only when said distinction means distinguishes that it is discernment data given to the optical disk of normal.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The optical disk which was applied to an optical disk and its regenerative apparatus, especially recorded a music title, game software, etc. checks strictly whether it is the product of normal, and this invention relates to the cure for preventing the unjust duplicate from which infringement of copyright is constituted.

[0002]

[Description of the Prior Art] Since the information is recorded with the digital data, also by many duplicates, DVD (Digital Video Disc) which are the optical disk used for CD (Compact Disc) which is an audio disk, or the record medium of a TV game, and the image disk which attracts attention further recently does not have degradation of tone quality or an image, and a duplicate more unjust than record media, such as a music magnetic tape of analog recording, tends to overrun it. When reproduced as an optical disk with which those optical disks are especially called a "pirate edition", great disadvantageous profit will be brought to a copyright person and a publishing company.

[0003] Therefore, while consideration also with the special Copyright Act is achieved, in the publishing company side, printing and stamping the identification information (a manufacture lot number, serial number, etc.) which shows that it is the product of normal to the mirror plane field by the side of the labelled surface and the most inner circumference of an optical disk, and managing manufacture and shipment is performed. . However, in printing and a stamp performing the aforementioned identification information, since the duplicate is also easy, the method which the front stirrup which forms the protective layer on the occasion of manufacture of an optical disk forms the through tube which sees from the core of a disk to the reflecting layer of a mirror plane field by the high power laser beam, and serves as a long bar code element in the radiation direction after forming, and constitutes a bar code symbol is proposed (JP,6-203412,A). Moreover, while recording the main information with the fixed coding means, the applicant for this patent The key information which shows the decryption means of the main information is recorded on the aforementioned mirror plane field etc. by the bar code symbol. The method (JP,7-85574,A) which decrypts and reproduces the main information by the decryption method in which a regenerative apparatus reads the key information and is shown using the information, Key information was given in the deformation mode of the pit which constitutes the main information, and the playback system (JP,8-124219,A) of reading the key information previously and choosing a decryption means etc. is proposed.

[0004] In addition, although there is also a cure only by the logical technique in which the above physical means are not involved among the cures which prevent the duplicate of a software product, generally the physical means are more more effective.

[0005]

[Problem(s) to be Solved by the Invention] By the way, although a duplicate becomes difficult rather than a method with printing to the conventional labelled surface, or the stamp to a mirror plane field when based on the method of JP,6-203412,A, a comparatively easy facility can perform easily forming a bar code symbol with a bar code element with wide width of face using a high power laser beam, and the processing cost is also cheap. It follows, so a duplicate is easy and it is a question which has the effective prevention effectiveness to the duplicate of an optical disk by the practical aspect.

[0006] On the other hand, although raising and depending for security and becoming an effective cure can be evaluate since the method of JP,7-85574,A or JP,8-124219,A makes reproductive good/failure determine with the difficulty of formation of key information relating with a regenerative apparatus side, the informational contents are not make to recognize directly visually, it comes out practically, and the case of a deformation pit [a bar code or] of being inconvenient increases. Moreover, as well as the case of JP,6-203412,A since formation of a bar code symbol is comparatively easy, the effectiveness will be lost by the method of JP,7-85574,A. Although a very high security function is realizable by the method of JP,8-124219,A since a special method called deformation of a pit is adopted The fall of the yield is unavoidable, while the complicated and advanced technique for modulating a very detailed pit is needed and an expensive facility is needed after the manufacture phase of a disk, or manufacture.

[0007] Then, by recording the detailed bar code symbol made to camouflage in a logo mark, a figure, etc. further, this invention had two incomes with the configuration by the side of a regenerative apparatus, made unjust reproduction of an optical disk difficult, and was created for the purpose of offering the effective preventive measures while recording the identification information of a disk by the aforementioned bar code symbol.

[0008]

[Means for Solving the Problem] The 1st invention is except the record section of the main information in an optical disk. By the optical pickup to the reflecting layer of the field in which read is possible A low consistency bar code symbol with wide module width of face and a high density bar code symbol with narrow module width of face are constituted from a bar code element which looked at from the core of a disk and was

formed in the radiation direction as a long through tube. Each aforementioned bar code symbol starts the optical disk characterized by constituting visually the character which can be recognized by making it arrange two-dimensional about a high density bar code symbol, using it two or more while having the identification information of the same contents concerning the optical disk.

[0009] And playback of the main information is preceded on the occasion of playback of the optical disk. The read control means which moves an optical pickup to the configuration field of a low consistency bar code symbol and a high density bar code symbol, and performs read of the signal of each bar code symbol while rotating an optical disk, A 1st filter means to pass only the signal component obtained from the low consistency bar code symbol of the signals which the optical pickup read in the control process by said read control means, A 2nd filter means to pass only the signal component obtained from the high density bar code symbol of the signals which the optical pickup read in the control process by said read control means, A 1st data origination means to create bar code data based on the output signal of said 1st filter means, A 2nd data origination means to create bar code data based on the output signal of said 2nd filter means, A storage means to memorize each bar code data which each aforementioned data origination means created, A distinction means to distinguish whether it is discernment data with which one which said storage means memorized of bar code data is given to the optical disk of normal, A comparison means to compare both bar code data that said storage means memorized, Only when it distinguishes that it is discernment data with which said distinction means is given to the optical disk of normal and said comparison means checks coincidence of both bar code data, the regenerative apparatus possessing a judgment means to give playback authorization of the main information on an optical disk is applied.

[0010] In addition to a low consistency bar code symbol as been except the record section of the main information and shown in the conventional technique to the reflecting layer of the field in which read is possible by the optical pickup, in the optical disk of the 1st invention, two or more high density bar code symbols in the mode visually recognized as a character (an alphabetic character, a graphic form, and notation) are arranged two-dimensional. Therefore, if the aforementioned character is constituted from an alphabetic character which shows the identification information of a proper etc. to an optical disk, the information can be made to check directly visually and practical facilities can be given. Moreover, even if discovered, since two-dimensional arrangement is carried out, it is very difficult [it / since it is camouflaged for the high density bar code symbol in the character discovery of the existence is difficult, and / it is high-density,

and] technically to perform perfect imitation. Therefore, in an inaccurate replica, even if it forms the low consistency bar code symbol, a character cannot be constituted from a high density bar code symbol, but it becomes easy to check the difference with the optical disk of normal.

[0011] Moreover, in order to make coincidence of a low consistency bar code symbol and a high density bar code symbol into playback authorization conditions, a high density bar code symbol plays a role of 2nd security information, and since it becomes an unreproducible optical disk if the high density bar code symbol arranged in the character expression mode is not reproduced completely, either, the practicality of an inaccurate replica can be made to lose in a regenerative apparatus.

[0012] 2nd invention is taken as the contents which give the identification information of the optical disk based on the fixed information on low consistency bar code symbol [in the optical disk of the 1st invention of the above], and high density bar code symbol operation-algorithm using both information. For example, the contents of information enciphered as the information on the bar code symbol of another side gave the decode key of the information on one bar code symbol can be given.

[0013] And while providing the read control means and the 1st filter means which are the same functional means as the 1st invention, the 2nd filter means, the 1st data origination means, the 2nd data origination means, and a storage means on the occasion of playback of the optical disk An operation means to calculate discernment data with the fixed operation algorithm corresponding to said optical disk using each decoding data which said storage means memorized in order to judge authorization/disapproval of the main information playback of the optical disk, A distinction means to distinguish whether it is discernment data with which the discernment data for which said operation means asked are given to the optical disk of normal, Only when said distinction means distinguishes that it is discernment data given to the optical disk of normal, the regenerative apparatus possessing a judgment means to give playback authorization of the main information on an optical disk is applied.

[0014] Since according to this 2nd invention the duplicate of an optical disk becomes difficulty more since a low consistency bar code symbol and a high density bar code symbol do not serve as a symbol pattern of the same contents, and the discernment data of an optical disk are called for based on the fixed operation algorithm using the enciphered information, a security function can be further raised from the case where it is the 1st invention.

[0014]

[Embodiment of the Invention] Hereafter, the optical disk of this invention and the

operation gestalt of the regenerative apparatus are explained to a detail using a drawing.

<<operation gestalt 1>> Drawing 1 first shows the top view (B) and the enlarged drawing of an important section of the read side face of the optical disk concerning an operation gestalt (A). In this drawing, 1 is an optical disk and the annular mirror plane field 4 is constituted by the field which is equivalent to the outside of the clamper field 3 by the inside of the lead-in groove section of the record section 2 of the main information. Here, the main information is not recorded on the reflecting layer which consists of a reflecting layer (metal layers, such as aluminum) infixed between the transparent plastic layer (carbonate layer) in an optical disk 1, and the protective layer here, but the aforementioned mirror plane field 4 is constituted as a mirror plane-like reflector.

[0015] A fixed central angle is separated to the reflecting layer of the mirror plane field 4, two low consistency bar code symbols 5 and 5' are formed, arrangement formation of many aforementioned bar code symbols 5 and high density bar code symbols 6 from which about 1/of of that width of face and height is 4 as compared with 5' is carried out two-dimensional among them, and the LOGO section 7 which constituted the character string of "DISC" in the hoop direction consists of this operation gestalt. Moreover, with this operation gestalt, each bar code element of the low consistency bar code symbol 5, and the 5' and the high density bar code symbol 6 has the same symbol pattern with which both sides express the identification information of an optical disk 1 while seeing it from the core of an optical disk and forming it in the radiation direction for a long time. Furthermore, the low consistency bar code symbol 5, and 5' and the high density bar code symbol 6 have the module width of face of the ratio corresponding to each size, and the width of face of a wide bar and a narrow bar and the width of face of a wide tooth space and a narrow tooth space have also become the correspondence ratio inevitably.

[0016] And if it sees in the hoop direction cross section passing through the abbreviation core of the width of face applied to radial [of the mirror plane field 4] in the part which gave the aforementioned low consistency bar code symbol 5, and 5' and the LOGO section 7, it has become like drawing 2 . In this drawing, although 10 is a carbonate layer, 11 is a protective layer and the reflecting layer 12 is infixed among those layers, a reflecting layer 12 becomes the mode which the bar code section equivalent to the low consistency bar code symbol 5 and the LOGO section equivalent to the high density bar code symbol 6 followed through the mirror plane section 13. The low consistency bar code symbol 5, 5', and each high density bar code symbol 6 are the methods of above-mentioned JP,6-203412,A, and the front stirrup which gives a protective layer 11

in the manufacture process of this optical disk 1 is constituted here by making a reflecting layer 12 condense a high power laser beam, and forming a through tube in that aluminum layer, before stiffening the given protective layer 11. Therefore, in the part of the through tube equivalent to the bar element of a bar code symbol, light does not reflect but the aluminum part equivalent to a tooth-space element reflects light with a reflection factor equivalent to the mirror plane section 13.

[0017] By the way, although the LOGO section 7 arranges many high density bar code symbols 6 two-dimensional as mentioned above and it is constituted, if it is visible as are shown in drawing 1 (B), and the LOGO of LOGO: "DISC" is only drawn in the mode which looks somewhat dark visually as compared with a surrounding mirror plane, and it does not see in a detail under a microscope etc., it cannot recognize that the LOGO side consists of high density bar code symbols 6.

[0018] And the aforementioned optical disk 1 is played with the regenerative apparatus shown in drawing 3 . However, the system circuit of drawing 3 is mainly a system circuit of the part relevant to the disk check in a regenerative apparatus, and the other part is omitted. The servo circuit where an optical pickup and 22 perform a spindle motor and, as for 23, 21 performs spindle tracking control etc. in this drawing, An actuator driver [as opposed to an optical pickup 21 in 24], the quantity of light detection amplifier with which 25 amplifies the detecting signal of an optical pickup 21, The low pass filter with which amplifier and 27 pass [26] only the low consistency bar code symbol 5 and the photodetection signal component by which it is obtained from 5' (LPF), The comparator which 28 sets threshold voltage to Vtb and makes the output signal of LPF27 binary, The decoder to which 29 decodes the output data of a comparator 28, and 30 Amplifier, The band pass filter which passes only the photodetection signal component by which 31 is obtained from the high density bar code symbol 6 (BPF), The comparator which 32 sets threshold voltage to Vtl and makes the output signal of BPF31 binary, The decoder to which 33 decodes the output data of a comparator 32, 34 is a microcomputer circuit (henceforth a "microcomputer circuit") which judges authorization/disapproval of playback of the optical disk 1 set in disk check mode while controlling the whole system of a regenerative apparatus in generalization.

[0019] Next, the operations sequence at the time of playing an optical disk 1 in the aforementioned system circuit is explained using the flow chart of drawing 11 . Moreover, drawing 10 is used from drawing 1 if needed in process of the explanation. In drawing 3 , if playback directions of an optical disk 1 are made to the microcomputer circuit 34, the CPU will perform the following procedures based on the control program

stored in ROM. First, with playback directions, disk check mode is set up and the control data in this mode is immediately outputted to the servo circuit 23 (S1-S3). And the servo circuit 23 starts a spindle motor 22, rotates 360 degrees or more of optical disks 1, and moves an optical pickup 21 in the rotation process by the distance equivalent to the radial width of face of the annular mirror plane field 4 of an optical disk 1 (S4).

[0020] Serial change with the rotational speed of an optical disk 1 and the migration location of an optical pickup 21 at the time of this control is shown in drawing 4 . That is, rotation of an optical disk 1 is started rapidly and shifts to a constant-speed condition, and the time zone rotated mostly about one time maintains the constant-speed condition, and after rotating one time, it carries out a ********** halt. Moreover, although the optical pickup 21 is moving from an initial valve position P1 to the last location P2, the time zone moves outside at uniform velocity when an optical disk 1 shifts to a constant-speed condition, and an optical disk 1 carries out [the time zone] constant-speed rotation, and the optical pickup 21 is carrying out [the time zone] uniform migration supports the read time of the low consistency bar code symbol 5, and the 5' and the LOGO section 7. Therefore, the relative migration locus of an optical pickup 21 to the read side face of an optical disk 1 is set to P1-P2 which were shown by the dotted line by drawing 1 (B), an optical pickup 21 will surely cross the low consistency bar code symbol 5, and 5' and the LOGO section 7, in the locus part of points a1-a2 at least, an optical disk 1 will carry out constant-speed rotation, and the optical pickup 21 will carry out uniform migration of it.

[0021] By the way, the output signal at the time of an optical pickup 21 crossing the low consistency bar code symbol 5 and the high density bar code symbol 6 of the beginning of the LOGO section 7 with the aforementioned read time band (read signal) serves as a signal wave form like drawing 5 . That is, as mentioned above, since both symbols 5 and 6 have the same pattern, the contents of a signal are the same [if drawing 2 is made to correspond, naturally the read signal in the part of the low consistency bar code symbol 5 will become the signal wave form of a long period, and it will become the signal wave form of a short period in the part of the high density bar code symbol 6 so that clearly, but / the symbols] only by having relation of roughness and fineness in the direction of a time-axis.

[0022] And although the aforementioned read signal is inputted into LPF27 through amplifier 26 from the quantity of light detection amplifier 25 and it is inputted into BPF31 through amplifier 30 from the quantity of light detection amplifier 25, LPF27 outputs a signal as made pass only the signal component concerning the low consistency

bar code symbol 5 and shown in drawing 6 , and since BPF31 passes only the signal component concerning the high-density bar code symbol 6, it outputs a signal wave form as shown in drawing 7 . More, LPF27 and BPF31 have frequency characteristics as shown by the dotted line of drawing 8 in the detail, and contain in it the spectrum of the signal which starts a passband at the low consistency bar code symbol 5, respectively, and the spectrum of the signal concerning the high density bar code symbol 6.

[0023] next -- although the output of each filters 27 and 31 is inputted into comparators 28 and 32, respectively -- a comparator 28 -- the P-P value of the signal wave form of drawing 6 -- almost -- middle -- threshold voltage Vtb -- a comparator 32 -- the P-P value of the signal wave form of drawing 7 -- threshold voltage Vtl is mostly set up in the middle, and the output signal of each filters 27 and 31 is made binary. Therefore, it becomes the pulse shape which shows the output signal of a comparator 28 to drawing 9 , and shows the output signal of a comparator 10 to drawing 10 .

[0024] And each aforementioned pulse shape is inputted into the decoders 29 and 33 prepared corresponding to each comparators 28 and 32, and each decoders 29 and 33 are decoded to the data stream which the microcomputer circuit 34 can process, and are outputted to the microcomputer circuit 34, respectively.

[0025] Here, it returns to the flow chart of drawing 11 , and it is incorporated from an I/O Port and each data is stored in Built-in RAM in the microcomputer circuit 34 which received each decoding data (S5). In addition, although aimed only at the signal of one low consistency bar code symbol 5 and the high density bar code symbol 6 read by the degree by drawing 7 and drawing 9 , and drawing 10 from drawing 5 As shown in drawing 1 in fact, after an optical pickup 21 reads one low consistency bar code symbol 5, Since many high density bar code symbols 6 in the LOGO section 7 will be read and one more low consistency bar code symbol 5 will be read, Much decoding data which require the decoding data concerning the low consistency bar code symbol 5 for two sets and the high density bar code symbol 6 will be stored in RAM over a set part. And after all of those decoding data are stored, rotation of an optical disk 1 is made to stop, and an optical pickup 21 is returned to an initial valve position (S6).

[0026] Next, the microcomputer circuit 34 compares the decoding data concerning the low consistency bar code symbol 5 stored in RAM with the discernment data beforehand stored in ROM (S7). In this operation gestalt, it has given as tolerance data of the serial number to which the discernment data of ROM may be given by this optical disk, and a lot number, and if an optical disk 1 is the product of normal, the data which each aforementioned bar code symbols 5 and 6 express will be contained in that tolerance data. Therefore, if the decoding data concerning the low consistency bar code symbol 5

are contained within limits which the discernment data of ROM show, it can be presumed that this optical disk 1 is the product of normal. However, it checks whether each decoding data of the microcomputer circuit 34 concerning the low consistency bar code symbol 5 which reserved decision even if it could check that the condition was fulfilled, and was further stored in RAM, and the high density bar code symbol 6 corresponds (S8). And it judges that this optical disk 1 is the thing of normal in the phase where that coincidence was also checked, the disk check mode set as the beginning is canceled, and it is made to shift to an original playback mode (S8 ->S13).

[0027] Thus, having imposed two check conditions, S7 and S8, by the time it finally decides the normality of an optical disk 1 has the following meaning. or [first, / that such a bar code symbol 5 is not attached by not checking whether the serial number by which the check conditions of S7 may be correctly given to this optical disk 1 by the low consistency bar code symbol 5, and the lot number are expressed] -- or when the permissible serial number etc. is not expressed correctly, it will be said that it is the optical disk reproduced unjustly. However, since it can perform easily forming the low consistency bar code symbol 5 by the cheap manufacturing facility, if the low consistency bar code symbol 5 of the optical disk of the normal made applicable to a duplicate is formed as it is even if it is the optical disk reproduced unjustly, the check conditions of S7 can be cleared, and the effectiveness for eliminating an inaccurate replica is lost. On the other hand, in order to clear the check conditions of S8, the high density bar code symbol 6 for which it was camouflaged by the LOGO of "DISC" as mentioned above must be found out, the high density bar code symbol 6 which needs reconstruction and the advanced technique of a facility must be formed, and most inaccurate replicas can clear this condition. That is, the security to an unjust duplicate can be raised by leaps and bounds on condition that a duplex.

[0028] and when the conditions of S7 are not filled with this operation gestalt, and when [even if it fills it,] the conditions of S8 are not fulfilled Clear the storing data of RAM immediately and the procedure of S3 - S9 is made to rerun (S7-S10 ->S3). furthermore, even if it repeats the procedure 3 times and performs it, when the check conditions of S7 and S8 cannot be cleared While the microcomputer circuit 34 considers that an optical disk 1 is a completely inaccurate replica and outputs the display-control signal of playback disapproval, discharge actuation of the optical disk 1 is performed, and it escapes from this disk check mode (S10-S12). In addition, it is for expecting the prudence of the last decision to perform the procedure of S3 - S9 3 times.

[0029] Moreover, in order to raise the dependability of a system, it is also effective to take the following measures.

(1) Since the decoding data concerning many the low consistency bar code symbols 5 and the high density bar code symbols 6 are stored in RAM, only when the coincidence conditions more than fixed are acquired, perform procedure it is considered that is the optical disk of normal, using all decoding data as a candidate for a comparison.
(2) Since the allowances of a tooth space can be expected in the mirror plane field 4 in the hoop direction, read each bar code symbol 5, 5', and by taking the large KUWAIETTO zone before and behind 6, and lessen an error.
[0030] Furthermore, although it is the arrangement mode in which the low consistency bar code symbol 5 of an optical disk 1 and the high density bar code symbol 6 of 5' and the LOGO section 7 always appear on the same radius mostly with this operation gestalt, both may be made to be located on another radius. Moreover, if this operation gestalt has the field which is an optical disk and is equivalent to the mirror plane field 4, it can be applied regardless of that class, and it can be applied to a variety of optical disks, such as not only CD but the mini disc and the MO disk of 2nd page lamination which are a typical optical disk, and DVD-ROM.
[0031] <<operation gestalt 2>> As opposed to the low consistency bar code symbol 5 of an optical disk 1 and the high density bar code symbol 6 of 5' and the LOGO section 7 in the operation gestalt 1 of ** above having had the information on the same contents, as for the description of this operation gestalt It has the information on the contents that the low consistency bar code symbol 5 and 5' enciphered the identification information of an optical disk 1. It is in the point that the procedures for judging an optical disk 1 in the point of having the contents as key information for the high density bar code symbol 6 decoding the enciphered information, and ** regenerative apparatus, each bar code symbol 5, 5', and by having made information on 6 into the aforementioned contents differ. In addition, with this operation gestalt, it is supposed that the identification information of an optical disk will be given for easy code information.
[0032] Therefore, although the symbol pattern is the same at drawing 1 concerning the operation gestalt 1 only by modular roughness and fineness being in the low consistency bar code symbol 5, and 5' and the high density bar code symbol 6 if it sees about an optical disk 1, with this operation gestalt, each bar code symbol (5 5') and the symbol pattern of 6 will be different, and the modes of the cross section of the reflecting layer 12 in drawing 2 will differ corresponding to it. Moreover, although the basic configuration of the system circuit shown in drawing 3 itself is the same if it sees about a regenerative apparatus, since two sorts of bar code symbols (5 5') differ from the contents of information of 6 as mentioned above, each signal wave forms of drawing 7 and drawing 9 , and drawing 10 will differ from drawing 5 used in the operation gestalt 1 for

explanation of a system of operation.

[0033] And the description of this operation gestalt is concretely explained by the flow chart of drawing 12 . First, the control sequence of S21-S26 in this drawing is the same as the case of the operation gestalt 1, and those procedures support S1-S6 of drawing 11 in the operation gestalt 1. By the way, completion of the procedure to S26 stores each decoding data concerning the low consistency bar code symbol 5 and the high density bar code symbol 6 of 5' and the LOGO section 7 in RAM of the microcomputer circuit 34 (S25).

[0034] With this operation gestalt, the decoding data of the low consistency bar code symbol 5 are decoded by using as a decode key the decoding data which require CPU for the high density bar code symbol 6, and the identification information which starts an optical disk 1 as that decode result can be found (S27). That is, the data of the low consistency bar code symbol 5 are enciphered, the assignment code of the program to which the data of the high density bar code symbol 6 decode the encryption algorithm is given, and CPU reads the decode program corresponding to said assignment code beforehand stored in ROM, and decodes the decoding data of the low consistency bar code symbol 5.

[0035] Moreover, the data in which the grant range of the identification information which requires this regenerative apparatus for the refreshable optical disk 1 is shown are stored in ROM of the microcomputer circuit 34. Then, CPU checks whether it is contained within limits which the data whose decode result obtained previously is ROM show, if it is within the limits, will cancel disk check mode and will shift to an original playback mode (S28 ->S33). On the other hand, in the aforementioned check, when a decode result becomes out of range CPU clears the data of RAM and the procedure of S23-S29 is made to rerun (S30 ->S23-S29). Even if it repeats the procedure 3 times and performs it as a result, when a check result becomes out of range While considering that ********** 1 is a completely inaccurate replica and outputting the display-control signal of playback disapproval, discharge actuation of the optical disk 1 is performed, and it escapes from this disk check mode (S30-S32).

[0036] Since it must constitute from a symbol pattern which can limit encryption data and the regenerative apparatus which can play an optical disk 1 for that decode key since he is trying to give by 6, each bar code symbol 5, 5', and, and is different in the high density bar code 6 of the low consistency bar code symbol 5, and the 5' and the LOGO section 7 according to this operation gestalt, that duplicate becomes difficulty more. In addition, although the data by the side of the low consistency bar code symbol 5 are used as encryption data and the data by the side of the high density bar code symbol

6 are used as the decode key of that encryption data with this operation gestalt, data may be given by reverse relation. Furthermore, the identification information of an optical disk 1 may be made to be called for by a certain function which did not consider as encryption data and the combination of a decode key, but made both data the variable.

[0037]

[Effect of the Invention] The optical disk of this invention and its regenerative apparatus do the following effectiveness so by having the above configuration. By this invention, although giving that identification information by the low consistency bar code symbol to the mirror plane field of an optical disk like the conventional technique can be reproduced comparatively easily, since he is trying for invention of claim 1 to make a high density bar code symbol arrange in a character configuration mode two-dimensional in addition to a low consistency bar code symbol, although it is realizable using a comparatively cheap facility, it needs an advanced manufacturing technology, it makes unjust reproduction very difficult, and offers effective duplicate preventive measures. Moreover, existence of a high density bar code symbol can be made hard to discover, since it is camouflaged for a high density bar code symbol in a character while being able to make a character into a logo mark, a serial number, etc. and being able to make the identification information of a disk check directly visually. Since he is trying for invention of claim 2 to give the identification information of an optical disk with a fixed operation algorithm using the information on a low consistency bar code symbol and a high density bar code symbol, it has two incomes a regenerative-apparatus side, and raises the security function to an unjust duplicate further. As a regenerative apparatus for the optical disk of claims 1 and 2, invention of claim 3 and claim 4 makes disapproval playback to optical disks other than the optical disk specified by those claims 1 and 2, and cancels unjust duplicates, such as a music title and game software, respectively. Moreover, even if the optical disk which gave duplicate preventive measures only by the low consistency bar code symbol spreads, it also has the advantage of it being possible to make it correspond only by switching the program for judging reproductive authorization/disapproval with a DIP switch etc., and being able to make compatibility secure without being accompanied by the hardware change.

[Translation done.]